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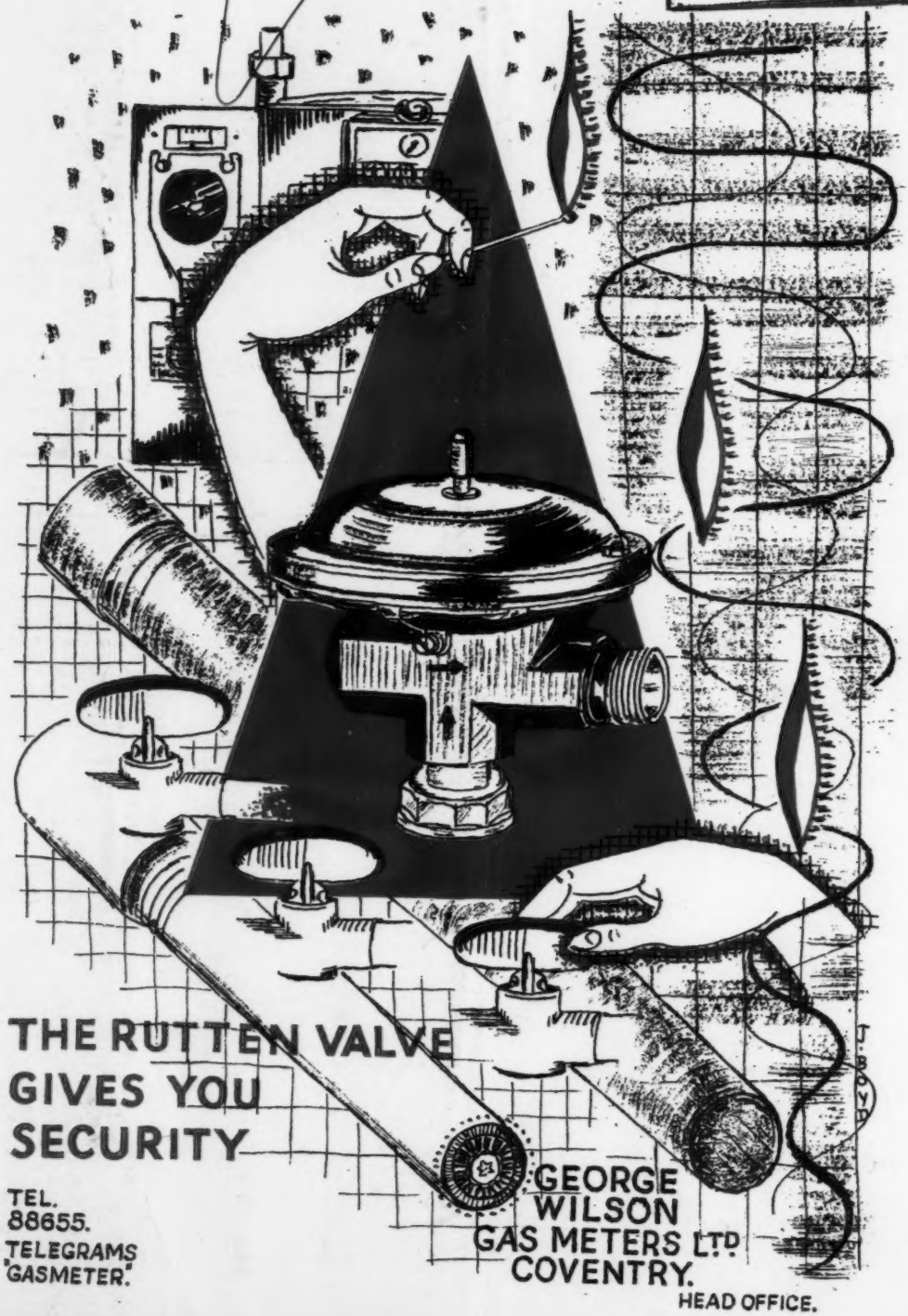

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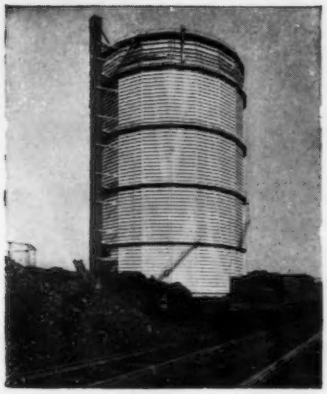

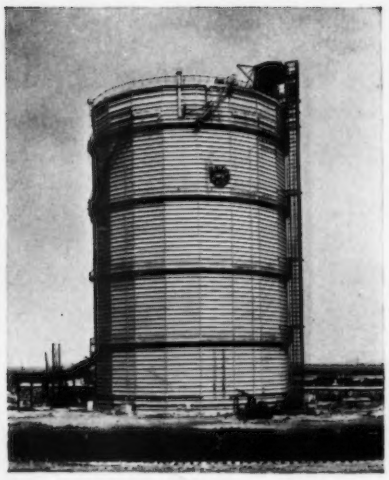

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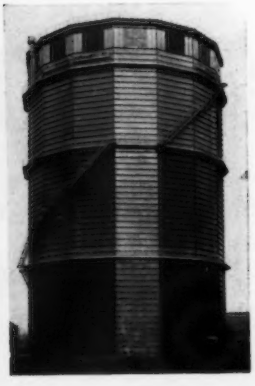

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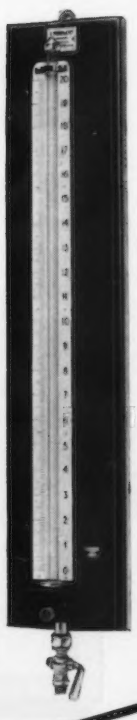

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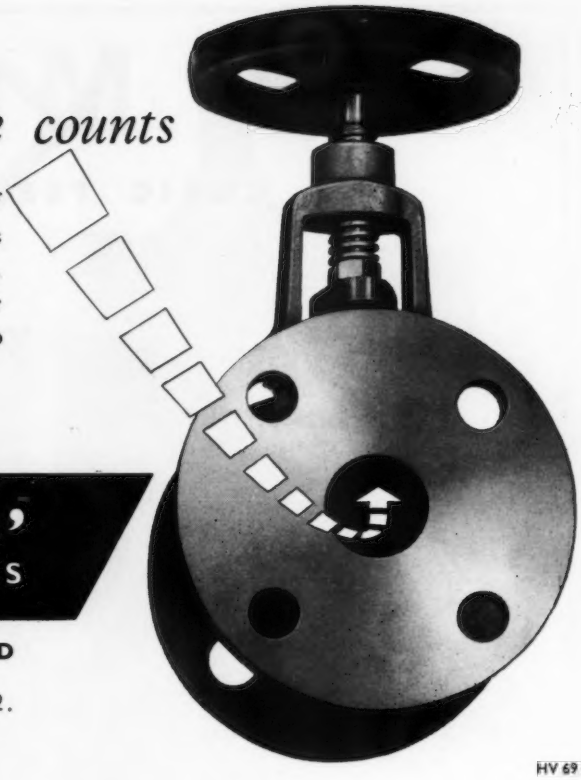

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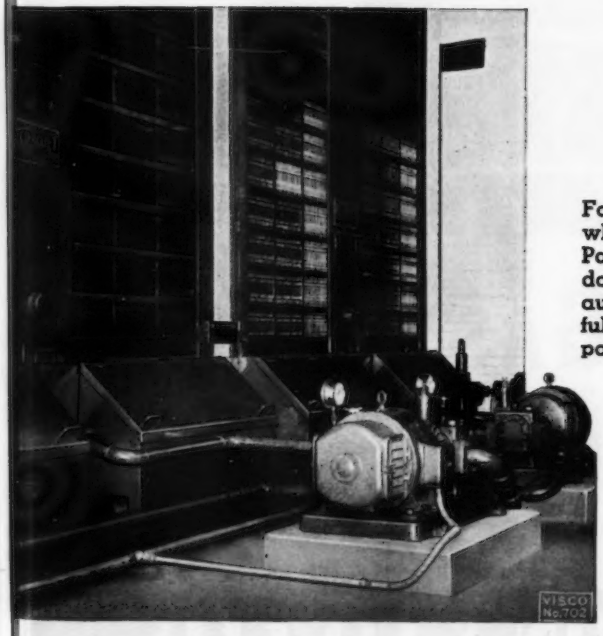

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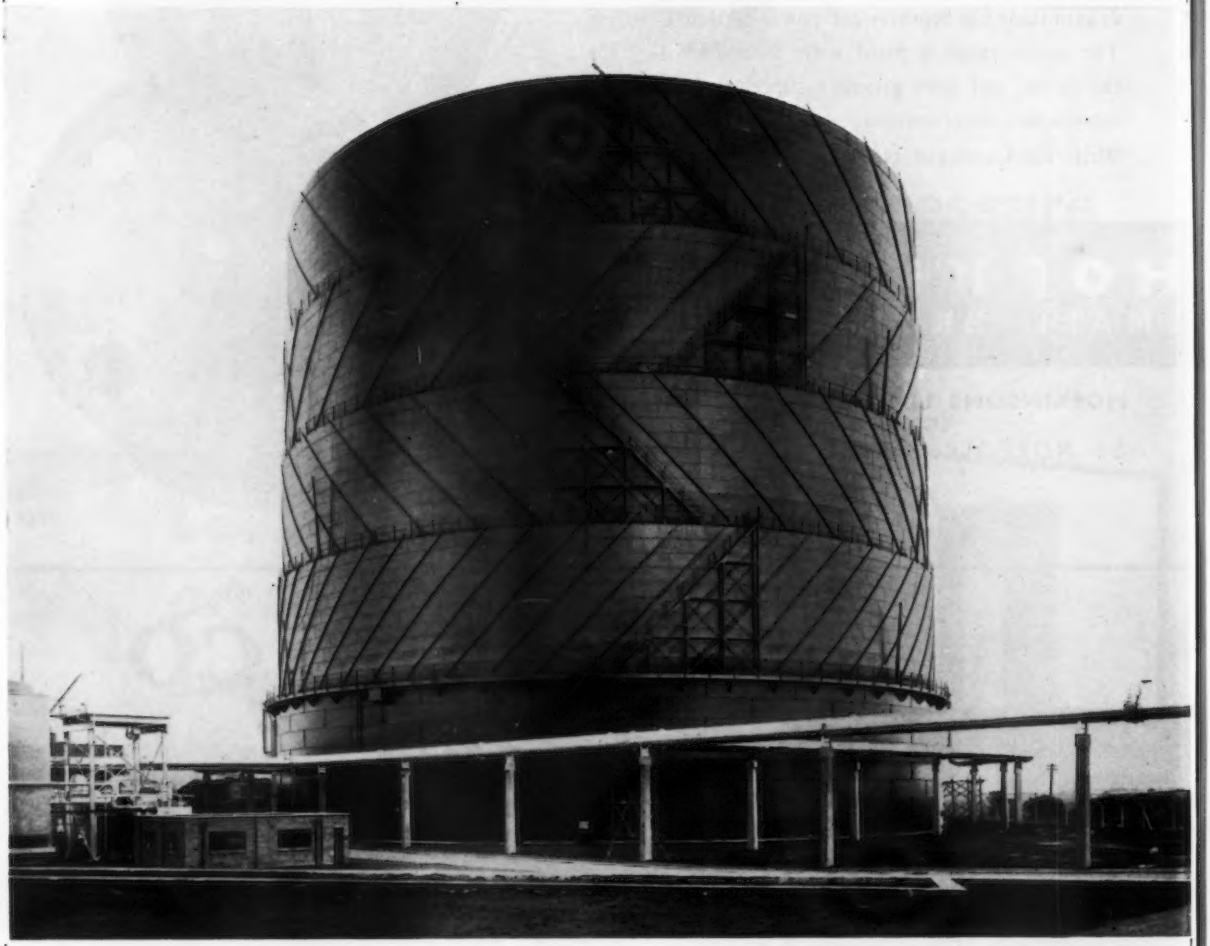

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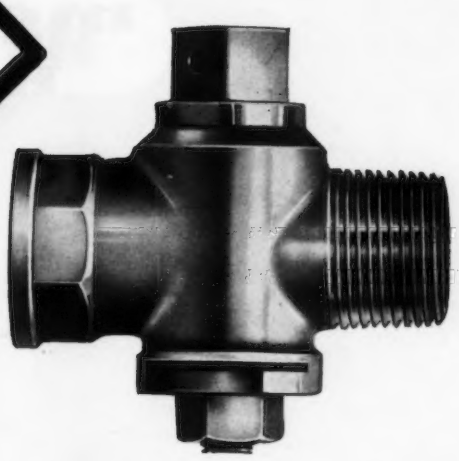

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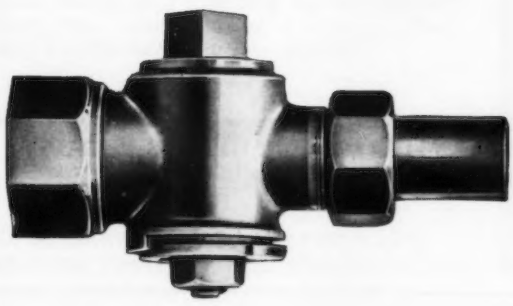

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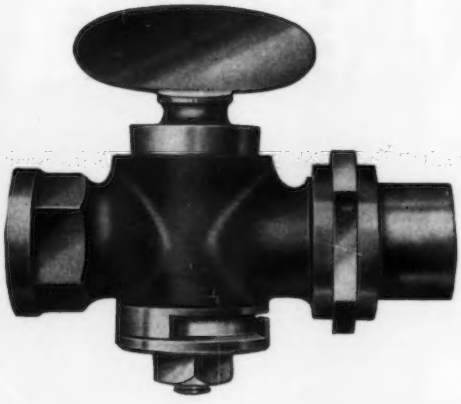

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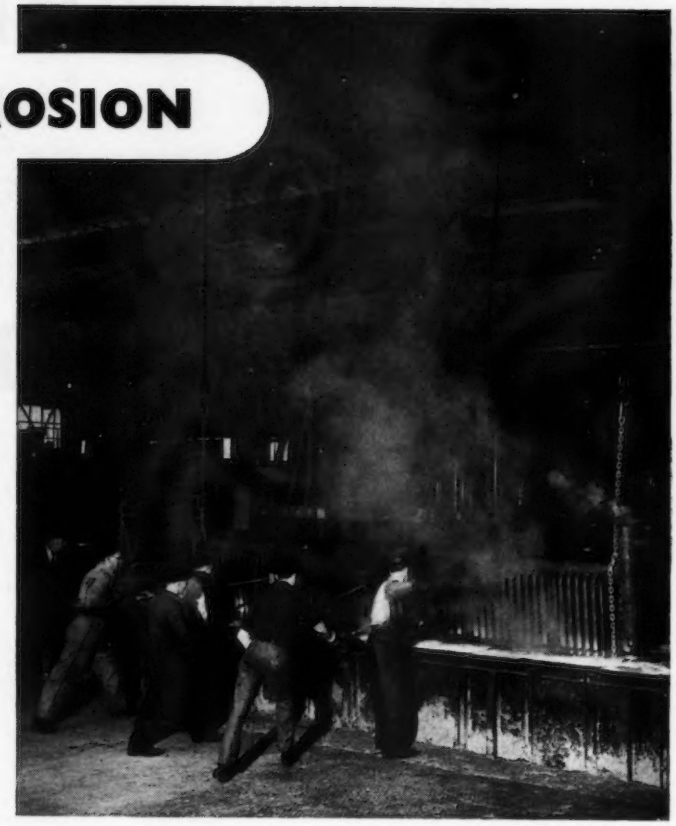

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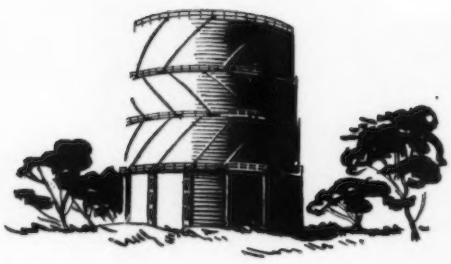

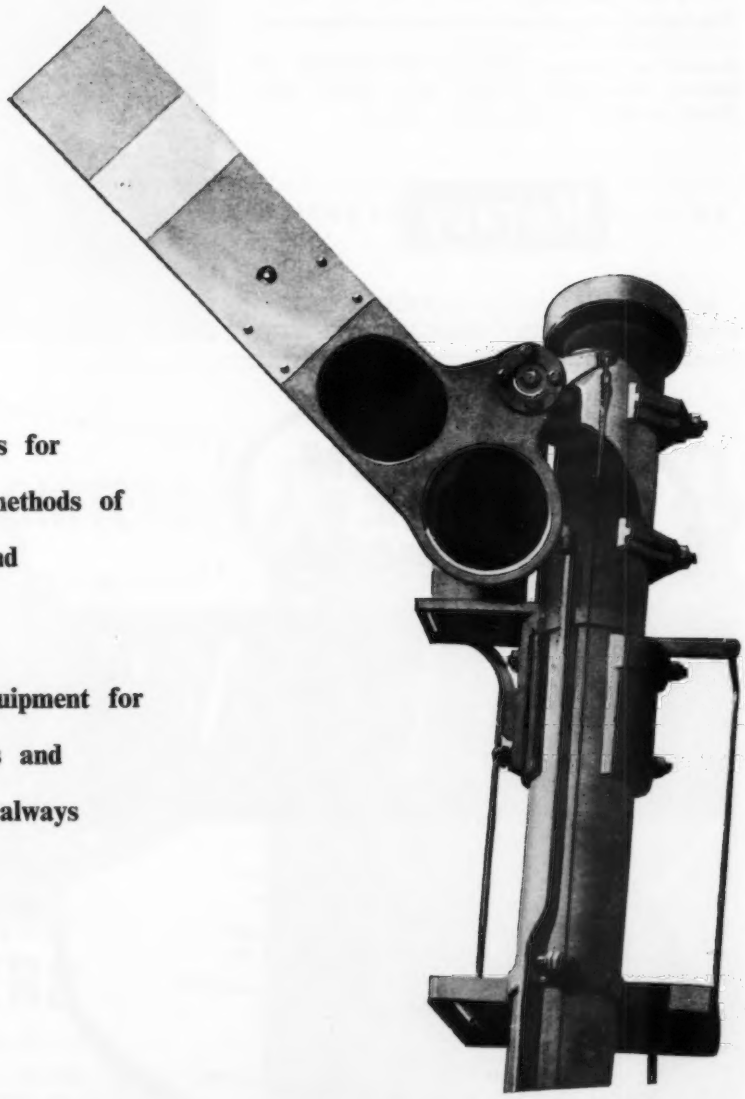

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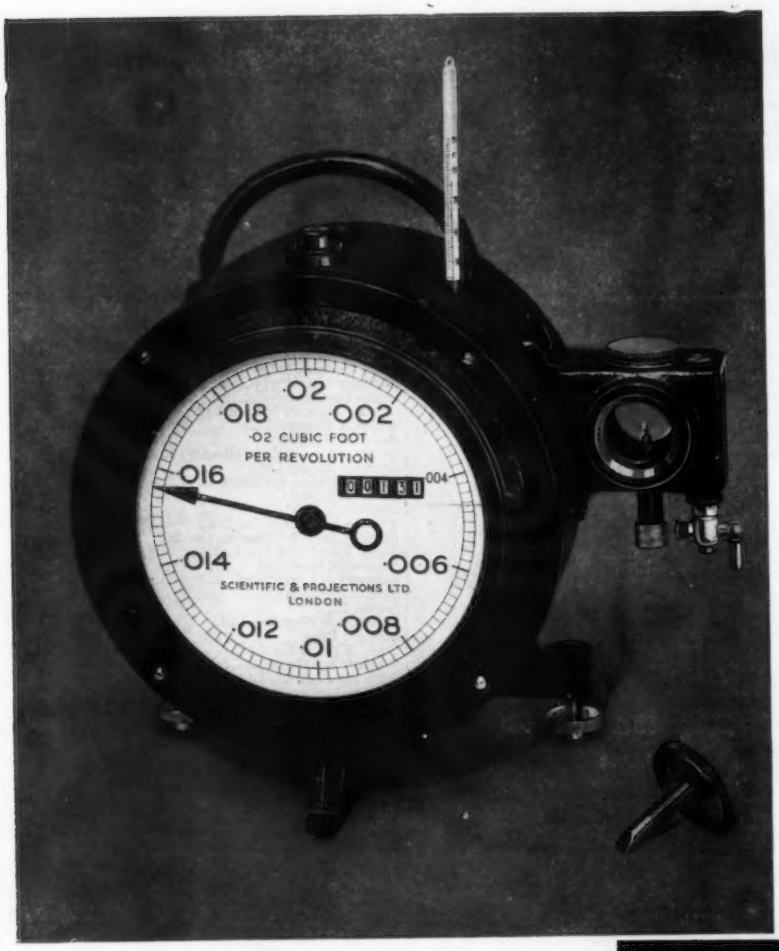

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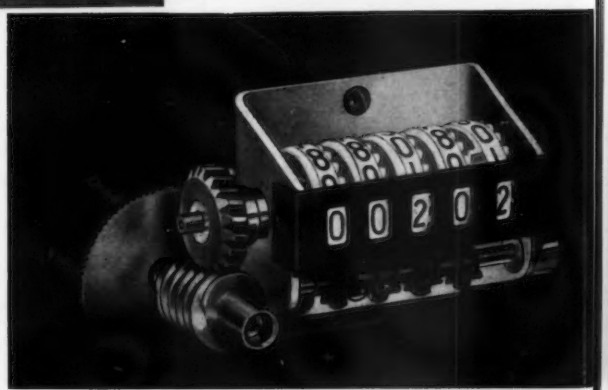

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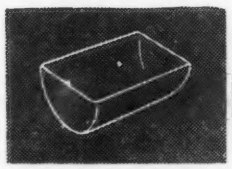
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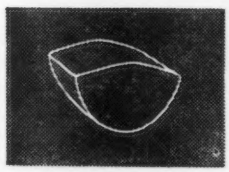
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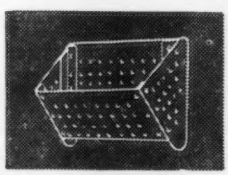
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Gas Journal

VOL. 291 NO. 4907 July 31, 1957

109TH YEAR

MANAGING DIRECTOR: Clifford A. King

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Published by Walter King Limited,
11, Bolt Court, Fleet St., London, E.C.4

Telephone: FLEet Street 2236-7 Telegrams: Gasking, Fleet

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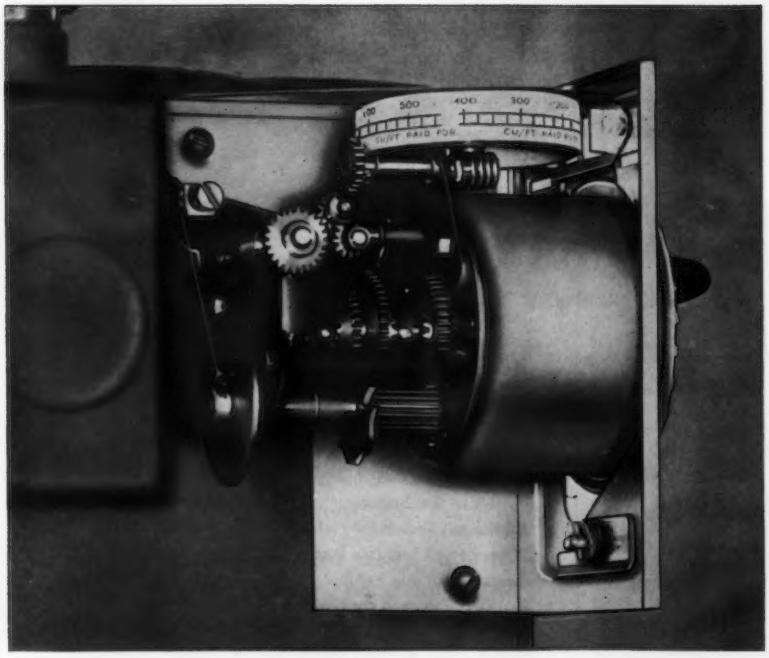

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Gas Journal

VOLUME 291. No. 4907. JULY 31, 1957. 109th YEAR

Railway Electrification—a Problem for Gas

WE are always hearing how the railways in some other country are superior and more modern than our own railways in Great Britain. We hear of the very high speeds being attained in France, the high standards of comfort achieved by the crack expresses in America, the fast businessman's service in pre-war Germany, or the feats of engineering in Scandinavia. So intense—one might say odious—have these comparisons become that our own railway system is commonly spoken of as being outdated, inefficient and hardly worth retaining.

These criticisms continue but the future holds promise. It was with a feeling of relief and encouragement that the announcement of the complete reorganisation of British Railways was received by the British public. Now we, too, could look forward to seeing our very complete and all embracing railway system brought up to date. The long delay in deciding whether or not main line electrification was going to be the thing of the future was over. Main line electrification had been adopted as the future policy of British Railways, with diesel locomotives for the interim period until electrification could be accomplished on main lines. Later diesel traction would be commonplace for all secondary connections, with diesel car units for branch lines. When the cost of this colossal programme was announced the figure was so astronomical that the ordinary layman gasped, but it did not worry him unduly. Clearly this was a job which had to be done and the money must be found somewhere. It might be that we could again make our railway system the best in the world.

Probably the lay public envisaged the conversion as consisting of laying a third rail through the railway system, but this was not to be. Such a method would be extremely costly and much too dangerous. Instead an overhead conductor system was decided on and after some delay, while waiting for the result of experiments in France on high tension overhead supplies, it was decided to use the French system. It appears that by adopting this method of overhead supply there will be a great saving in the cost of conductors and less delay in the building of sub-stations, rectifiers and other ancillary plant. The use of high tension alternating current will make it possible to transmit the current over longer distances and so reduce the number of sectional feeding points.

So far so good, but there are snags. When the modernisation scheme was announced there was a good deal of talk about civil engineering work being necessary before much of the work could be completed. To the public, perhaps, it might have appeared to be necessary because the trains were going to run faster. After all, since passenger train speeds on the Continent have reached over 120 miles an hour, speeds of 100 miles an hour for scheduled running should not be impossible with our new railway system. This might mean the straightening out of certain sections, or perhaps increasing the super-elevation on certain stretches to make individual curves safer at the higher speeds.

The civil engineering work is indeed this—and very much more. The loading gauge on British Railways is lower than on the Continent and involves the clearances between rolling stock, tunnels and bridges. The effect, too, of electric and diesel locomotives with their smaller wheels is to pound the permanent way far more than steam locomotives. The outcome of these problems is that all bridges must be raised and the track through all tunnels must be lowered before the overhead conductors can be installed, and the track foundations throughout must be remade.

How does all this affect the gas industry? Unfortunately, it would appear that it may have a profound effect. First there is the influence of high tension earth returns. These, it seems, can have a very considerable effect on the corrosion of steel gas mains. With the development of the many grid systems, there are more and more steel mains being laid for high pressure gas

transmission. Should a main be running near such a high tension system, it is very likely that stray currents will enter the main and start serious corrosion. At the same time there is a possible danger of unbridged mains when repair work is in progress.

The civil engineering work is likely to have its repercussions on the local gas distribution engineering departments. It is not uncommon to see gas mains crossing railways by the railway bridges. Where this happens it will be necessary to dismantle the gas connections before the bridge can be jacked up, with a consequent interruption in gas supplies.

In some places where the cover of earth above tunnels is not very deep—and this might occur in a semi-urban area—British Railways may decide to dispense with the tunnel and convert it into a deep cutting. What is going to happen if there are other public utility services buried in the tunnel covering? The absence of the tunnel covering as a means of carrying the gas main or services may isolate a whole district and involve the local gas undertaking in quite an extensive main laying scheme.

The first section of the main line electrification scheme which will be using the overhead high tension method of power supply is now under construction between Crewe and Manchester and this will later be extended to Liverpool and, eventually, the whole way to London. It is calculated that sub-stations may be about 30 miles apart, the first one out of London being at Hemel Hempstead. Will this mean that in the vicinity of the main line, for a distance of 30 miles between sub-stations, all steel mains laid in the ground are liable to heavy corrosion? On the Continent, especially in Switzerland, equipment has been installed to prevent the earth return currents straying from the earth return rail. Such equipment installed over the very much more extensive main line system in Great Britain would be so expensive as to be prohibitive.

The problems of how to overcome the effects of main line electrification are already being faced by the area board through which construction work is proceeding at the present moment. As the electrification programme proceeds these problems may become among the most serious facing the gas industry.

The Last Round-up

FOR an Englishman there is something about his affection for horses unequalled by any other man-and-animal relationship. Since the passing of the ox-drawn team, the horse has been symbolic of the ordinary Englishman's honest endeavour, and no one who has laboured for long at a task with this diligent and long-suffering animal can fail to be moved when the diesel and petrol engine make its existence uneconomical.

For Londoners, particularly, that sad day has arrived again. Traffic conditions have been chiefly responsible for dwindling numbers of North Thames Gas Board horses—as recently as 1952, Fulham stables were closed. The few remaining horses, used for delivering coke, continued to work from Brentford. Now, they too have gone. Except for a few employed inside Beckton works, there are no more N.T.G.B. horses to be seen—the last of them are enjoying the remainder of their lives on specially selected farms.

No more will they sweep the cart-horse board at the International, Richmond and other shows, or delight the crowds at the Cart Horse Parade in Regent's Park. For the genuine Cockney this is a serious blow at his natural surroundings—why, it is almost as unbearable as pulling down Tubby Isaac's jellied-eel stall for road-widening.

Swing, Swing Together

IT has taken eight years of nationalisation to achieve what would be regarded by any other large business concerned as a fundamental principle of commercial practice. For the first time advertising is to be co-ordinated throughout the industry and every area board is going to publicise and concentrate on selling the same type of appliance at the same time. Formerly it was not uncommon to find two quite different campaigns in progress in adjacent boards. Not only did this reduce the sales impetus throughout the areas but it caused considerable confusion along the board boundaries. Worst of all it was not possible to support these events by national publicity, which had to be limited to prestige advertising.

Happily those days of contradictory effort are past and we can now look forward to unified effort on the part of all concerned with—we confidently expect—a marked improvement in results. Commencing on September 16 and continuing until October 10 the whole industry is embarking on a space heating campaign designed to lend direction and impetus to this sadly neglected section of our business. The campaign will be in the nature of a trial run and any teething troubles which may emerge should be ironed out by the time the second campaign—cooking—appears in November; there will also be a national water heating campaign in March. Actually it is hoped that there will be four campaigns in 1958, the extra one probably being devoted to refrigeration.

The very attractive Gas Council layouts will be broadly followed in the provincial advertising to be carried out by area boards and the appliance manufacturers. We look forward to the new campaign—which will be entitled ' Mr. Therm's Winter Warmth Parade '—with a good deal of enthusiasm.

Rather Fishy

THE Tea Centre, which in our old-fashioned way we used to associate vaguely with tea, now seems to be given over to jam, detergents, milk, margarine, mushrooms and bacon, etc. These products are the subject of a series of demonstrations in the organisation of which various bodies are co-operating with the Gas Council. The series got under way a fortnight ago with highly successful demonstrations of ' Summer Fare,' some of which were attended by numerous overseas visitors. Last week it was the turn of Ascot Gas Water Heaters, Ltd., who held a ' Hot Water for Health Week ' exhibition, and now the White Fish Authority has taken over with a ' Fish Week ' during which cookery demonstrations by North Thames home service advisers are being held three times a day.

Our invitation card bade us visit ' Mr. Therm and the Whispering Fish,' the significance of which has yet to be whispered to us. Mildly surprised by this wording, we were quite astonished to find that although specialist visitors during the week would include experts in schools, hospital and industrial catering, not to mention the Fish Fryers' Association, only one fish fryer—a small one used for the actual demonstration—was on show. This despite the fact that there was ample space and an excellent opportunity for showing how great is the range of appliances which the gas industry can offer for this purpose.

Personal

MR. R. C. ARNOLD, Group Manager for the East Midlands Board, was presented with a gold wrist watch subscribed by his colleagues to mark his coming emigration to Australia at a recent farewell party at Spalding, Lincs., gasworks. He is joining the Colonial Gas Association, Ltd., in Melbourne, after ten years at Spalding. The presentation was made by MR. H. C. ROBINSON, Deputy Engineer and Manager. When replying, Mr. Arnold handed to Mr. Robinson a silver cup to be awarded as a prize in a competition to be arranged by the local Sports and Social Club Committee.

MR. J. H. BRIDGE, Showroom Manager of the Stockton Unit of the Tees-Side Division of the Northern Gas Board, has retired after 46 years' service, the whole of which was spent at Stockton. Mr. Bridge was a member of the Institute of Fuel and a Past Chairman of the North of England Gas Salesmen's Association.

RAMS GOLFING SOCIETY HOLDS ANNUAL MEETING

WINNER of the Stapleford competition against bogey at the recent annual open meeting of the RAMS Golfing Society at the Richmond Golf Course, Sudbrook Park, was Mr. J. Elliot Clarke, Honorary Secretary of the Society, with 43 points. Second was Mr. H. Barratt (Hitchin) with 37⅜ points, and Mr. A. W. Smith (Wandgas) with 37¼ points was third.

Prizes for the best first and second halves were won by Lt. Col. R. A. R. Fanshawe (RAMS) and Mr. Alan Davies (Tottenham) respectively, while the consolation prize was won by Mr. R. S. Falkner (Ipswich).

SPORTS PAVILION WINS AWARD

THE University College (Cardiff) sports pavilion at Llanrumney has been adjudged the best public architectural project in South Wales over the past ten years.

It has won the South Wales area bronze medal of the Royal Institute of British Architects for the firm of T. Alwyn Lloyd & Gordon, of Cardiff, who planned the two-storey pavilion and sports ground.

This firm are the Consultant Architects to the Wales Gas Board, and were responsible for planning the new showrooms of the Board at Swansea, which were also considered for the award.

Duke Sees Gas Council Stand

The Duke of Edinburgh chats to attendant Mr. E. A. Waters on the Gas Council's exhibition stand at the Seventh World Congress of the International Society for the Welfare of Cripples in London this week. Mr. Waters is a North Thames Gas Board representative.

Sc.G.B. PLACE £250,000 TOWER PURIFIER ORDER

THE Scottish Gas Board have placed a contract worth more than £250,000 with Henry Balfour & Co., Ltd., of Leven, Fife, for a block of the latest type of tower purifiers at their Granton gasworks, Edinburgh. The plant will take about a year to erect.

Henry Balfour's have erected two blocks of tower purifiers the same size as those to be made for Granton in the London area. They have also obtained contracts for a block at Rotherham and another at Worcester.

Commenting on the new development, Mr. T. S. Ricketts, Chief Engineer of the Scottish Gas Board, said: 'There are comparatively few gas purifiers of this type in Britain. The new block at Granton will be capable of purifying 12 mill. cu.ft. of gas a day.

Existing installations at Granton purify about 30 mill. cu.ft. of gas per day.

Eight Receive Long Service Awards

The West Midlands Gas Board, Wolverhampton and District (No. 2) Division, recently presented long service awards to (left to right) Mr. Stanley Jones, Divisional General Manager; Mr. and Mrs. G. H. Cooper; Mr. and Mrs. R. V. Jarvis; Mr. W. R. Branson, Deputy Chairman; and Mr. and Mrs. H. Wallett.

Low Temperature Group

The Low Temperature Group (The Physical Society) and The Institution of Chemical Engineers are jointly organising a one-day conference on 'Recent Developments in Industrial Low Temperature Gas Separation' on November 26, at The Royal Institution.

The Gasfitter's Wife

A gasfitter employed by the Scottish Gas Board in Aberdeen had a day off recently to see his wife 'capped' M.A. with honours in psychology at Aberdeen University graduation ceremony. The new M.A., 27-year-old Mrs. Eva Foote, is the mother of two children.

Northern Gas Board Drivers Win Road Safety Awards

SOME 300 drivers were entered by the Northern Gas Board in the 1956 Safe Driving competition, the first year during which the majority could qualify for their first five-year medals since their initial entry.

Presentations were recently made in three of the Board's administrative divisions in the presence of prominent persons concerned with the Road Safety Campaign, who handed the awards to the successful drivers.

At Darlington, Alderman C. Anderson, Chairman of the Road Safety Committee, made the presentations. Alderman Anderson was a member of the Gas Committee when the undertaking was owned by the Darlington Corporation, and is now a member of the Gas Consumer Consultative Council in the Northern Area.

In the Cumberland Division the awards were presented by Mr. W. H. Lakeman, Chief Constable of Carlisle. Following the presentations Mr. Lakeman held an informal discussion with the drivers upon hazards they encountered when driving within the city.

Mayor Officiates

The awards at Sunderland were presented by Alderman J. Hoy, M.B.E., Mayor of Sunderland, Chairman of the Road Safety Committee, and a part-time Member of the Northern Gas Board, in his capacity of Chairman of the Consumers' Consultative Council.

The Divisional General Managers of each of the respective divisions, and other divisional officials, were present at the ceremonies. At each of the functions Mr. L. A. Garratt, the Board's Industrial Relations Officer, addressed the recipients, stressing the purpose of the competition and the value of the awards.

European Gas Statistics

THE first annual *Bulletin of Gas Statistics for Europe* was recently released by the United Nations Economic Commission for Europe (ECE). The *Bulletin* is a publication of the ECE's Secretariat.

Statistics in the *Bulletin* have been obtained from 21 European governments in answer to a questionnaire prepared jointly by the Secretariat and the International Gas Union. The tables in the *Bulletin* gives statistics for gas available for production, industrial exchanges, trade, stocks, and consumption, as well as for gas distribution, industrial consumption of gas, and international gas exchanges.

This is the first publication in which gas statistics have been compiled from both Eastern and Western European countries.

Chemical Engineers

The Council of the Institution of Chemical Engineers has decided to support the Chemical and Petroleum Engineering Exhibition, which will be held at Olympia, London, in June, 1958, by organising a symposium on 'The Organisation of Chemical Engineering Projects,' to take place at Olympia at the time of the Exhibition.

Best Kept Vehicle at Cardiff

The badge pictured above will be seen for the next year on the vehicle driven by Wales Gas Board, Cardiff undertaking, Driver E. Parle, this year's winner of the undertaking's 'best kept vehicle' competition. In addition to the badge, Driver Parle received £10 prize money. National Safe Driving Certificates were awarded to 26 of the undertaking's drivers.

ADDITIONAL SEARCH FOR NATURAL GAS

THE British Petroleum Exploration Company in conjunction with Imperial Chemical Industries, has re-started test drilling for natural gas in the Eskedale (Whitby) area of North Yorkshire. Two previous wells—one drilled before the war, the other in 1954—found some gas in Eskedale.

The purpose of the well now being drilled is to determine as far as possible the extent of this potential gas field and to estimate whether sufficient gas is present to justify the cost of building a pipe line to carry it to I.C.I's works at Billingham and Wilton on Teeside.

This investigation is distinct from the search for natural gas undertaken by B.P. Exploration Company on behalf of the Gas Council.

Autumn Conference

A Conference will be held by the Combustion Engineering Association on November 5 and 6, at Harrogate, Yorks. to examine the annual report of the National Industrial Fuel Efficiency Service; analyse the findings of N.I.F.E.S. engineers in their work with industry and to highlight the inefficiency which has been found in the use of fuel.

MR. DAVID RENTON VISITS POINT OF AYR

Mr. David Renton, Parliamentary Secretary to the Ministry of Power, recently visited the Point of Ayr colliery, a unit of the North Western Division of the National Coal Board, in connection with the utilisation of methane which this colliery obtains from underground borings. He afterwards visited the Point of Ayr methane station of the Wales Gas Board, where he is seen, left of front row, with Mr. T. Mervyn Jones, Chairman of the Wales Gas Board; Mr. G. H. Barker, Station Engineer; Mr. T. J. Sales, Marketing Officer of the National Coal Board; Mr. E. M. Edwards, member of the Wales Gas Board; and Mr. G. Barker, Deputy Chairman of the North Western Division of the National Coal Board.

Gas Prices Continue Upward

FIVE MORE BOARDS ARE AFFECTED

NEWS of price increases comes from five more of the area gas boards—the North Thames, North Western, East Midlands, Eastern, and Southern Boards.

Announcing the North Thames Board increase of 2d. a therm—bringing the price to 25.85d. a therm—Mr. Michael Milne-Watson, Chairman, said that hopes held a year ago of being able to peg prices till the end of 1958 had been 'completely falsified by another round of increases.'

Of the 7s. 2d.-a-ton increase in the price of coal which the Board would have to pay, Mr. Milne-Watson said coal accounted for 40% of the Board's expenditure and their whole economy was upset by any increase in its price and cost of carriage. Increases in freight rates announced for August 1 would also affect the prices of most other materials they bought. Wages and salaries were 22% of their expenditure, and the increases recently agreed by national negotiating machinery would seriously affect their whole range of operations.

For the next financial year, 1958-59, their estimates were increased over those of a year ago as follows:—

	£
Coal	1,819,000
Freight and lighterage charges	456,000
Wages, salaries and pensions	907,000
Oil	257,000
Rates	170,000
Interest and depreciation...	176,000
Materials for maintenance and contractors' charges	300,000
Total	£4,085,000

Against this £4,085,000-increase in costs they expected to set off increased revenue from coke and breeze owing to approved increases. This, added to increased revenue from tar products, should amount to £1,481,000, leaving an estimated net increase in operating expenses of £2,604,000.

There were two major reasons why this sum could not immediately be saved by increased efficiency. As the physical successor of the Gas Light and Coke Company, the North Thames Gas Board had long had a policy of integration and production economies, leaving only marginal opportunities at the moment for operational savings—although economies were continuing to be sought and achieved. In the second place they were committed to manufacture and distribute gas at all times that it might be required, which necessitated a large amount of expensive stand-by plant.

The increase in the N.T.G.B. price of gas will take effect on August 14.

After keeping their price of gas unchanged for two years, the North Western Board are now raising their domestic price by 1½d. a therm, and other prices by smaller amounts, because of £3 mill. additional charges arising from increased costs of coal, wages and salaries, rates, and freight, as well as higher capital and other charges.

The increases will take effect after the next meter readings, and to the average householder will represent an addition of 3d. per week on gas bills. The Board has undertaken to absorb by increased efficiency one-sixth of the heavily increased costs confronting it.

'£3 mill. is much too much to absorb by economies and improved productivity when we have already increased our productivity so steeply (10%) during the past two years, but my Board are determined to absorb at least £½ mill. of it,' said Mr. D. P. Welman, Chairman, when he announced the new tariffs to the North Western Gas Consultative Council.

One Lucky Town

In a world of rising gas prices, one town is lucky. The price will be cut by 1d. a therm in Aylesbury, Bucks. This is due to integration. Gas-making in the area has ceased and supplies are being received from Oxford and Reading.

If inflation could be checked he had no doubt that gas prices could be reduced, continued Mr. Welman. Inflation would undoubtedly continue unless the national output of goods and services at least kept pace with the consequent increase in available cash and credit.

The solution lay in two things—increasing use of automation and an intelligent compact between employers and employees to put into the national hot pot slightly more than they took out of it.

'It is two years since we were last forced to increase our prices. We shall do our utmost to hold our present prices again for the same period,' he concluded.

After holding their prices steady for a year, the East Midlands Board are raising them by just under 3½d. a week to the average domestic customer. 'But despite these increases,' said Mr. R. S. Johnson, Chairman, 'the average price of gas for all purposes in the East Midlands is still the cheapest in the country.'

Recent increases in coal prices, wages and salaries, freight charges and miscellaneous materials, have added £1¼ mill. to the Board's annual bill. The Board has undertaken to absorb about £.25 mill. by further increases in efficiency, made possible by new plant and grid main systems developed over recent years.

To shield the smaller customer, some of the increased charges which could properly have been applied to the 0 to 10 therms a quarter block, have been absorbed by the Board. A small domestic customer using 10 therms a quarter will have to pay at the most 1½d. a week more. The increases work out at about 8% on each block of the tariff.

The Board has also announced an optional two-part tariff for domestic customers. The existing general purpose tariff offers strong inducement to the small domestic customer to increase his consumption. The new two-part tariff is designed to encourage the larger domestic customer to increase his consumption still further.

Increases range from ½d. to 1½d. a therm in the area of the Southern Board and will take effect from the first meter reading after August 4. In the Eastern Board area they vary between 1d. and 3d. a therm from the middle of August.

TWO HIGHER TARIFFS IN N. IRELAND

IN Northern Ireland, Belfast and Bangor, Co. Down, gas prices have been increased by 9d. per 1,000 cu.ft. as a result of the higher coal, wage, and freight costs, adding some 4d. a week to the average householder's gas bill.

This is the second increase in Belfast's gas price this year. In March it went up by 6½d. per 1,000 cu.ft. to meet loan charges, dearer coal, and higher wages.

Mr. J. L. Hyslop, Engineer and Manager of the Gas Department, told Belfast Corporation Gas Committee that taking into account the latest increase in coal costs and subsequent rise in rail freights the total increase for which they had to provide, amounted to £171,400 per annum.

Councillor George Kelso, Chairman of the Gas Committee, said after the meeting that even with the new charges, Belfast's gas would still be cheaper than that in comparable cities in Britain.

At the meeting of the Bangor Borough Council at which it was decided to increase the price of gas to 8s. per 1,000 cu.ft. inside the boundary and to 8s. 8d. outside the boundary, Councillor S. Napier, questioned whether the gas undertaking was not in danger of pricing itself out of the market.

Alderman F. Logan, Chairman of the Gas Committee, complimented the Gas Manager, Mr. J. A. Derbyshire, who, he said, was doing his best to keep the price of gas as low as possible. They produced the cheapest gas in the country, he added.

BENZOLE REFINING EXHIBIT

NEW ADDITION TO SCIENCE MUSEUM

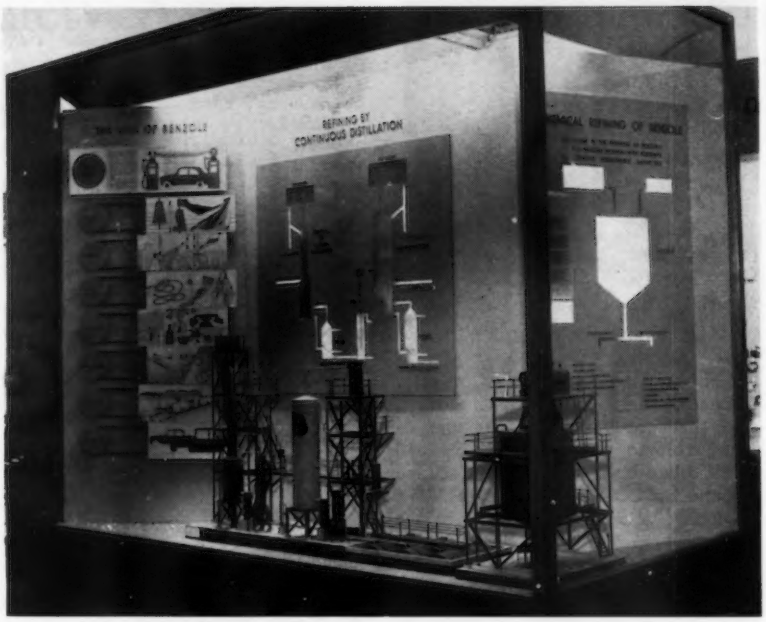
A benzole refining exhibit, sponsored by the National Benzole Association, has been erected in the industrial chemistry gallery at the Science Museum, South Kensington. The formal presentation took place on Monday.

The exhibit occupies an island showcase in the gallery. Close by are exhibits of the tar and petroleum industries and together these three exhibits feature the principal sources of raw materials for the chemical industry. The benzole exhibit consists of six panels, three of them animated, and four models, which show the origin, history, refining, and uses of benzole.

Origin in Java

The history of benzole began when Ibn Batuta, an Arabian traveller, brought back from Java a sample of Luban Javi —frankincense of Java. This name became successively banjawi, benjui, and benzoin; the material is now known as gum benzoin. In 1608, Turquet de Mayerne found that when benzoin was heated, crystals of 'flowers of benzoin' were obtained. These crystals were, in fact, benzoic acid, and in 1834, Mitscherlich produced benzene from them by distillation with lime. The same material had been obtained by Faraday some nine years earlier from compressed oil gas.

It is not clear who first obtained benzole from coal carbonisation. However, by 1848, Mansfield had developed a still for the distillation of benzole from coal tar, and a drawing of this still is shown in the exhibit. Coupier's still (1863) was one of the earliest for purifying benzole to be used on practical scale, and a model is shown. The modern methods of extracting benzole from the gas, as well as by distilling it from the tar obtained in coal carbonisation are indicated in the exhibit.



View of the exhibit

The refining of crude benzole is demonstrated by three models of plant each backed by an animated panel showing how the plant operates. A continuous-distillation unit is shown consisting of two columns from which are obtained fore-runnings, benzene, and toluene fractions and a residue. The chemical refining of benzene is represented by a washer showing the sequence of operations in a typical treatment. The third model is of a batch still. Where possible, the models have been cut away to show the inside of the plant. Particular care has been taken in relating the models and the panels.

Finally, the many uses of benzene are illustrated on a static panel. Although benzene finds its biggest outlet at present in motor spirit, it is becoming increasingly important as a raw material for the chemical industry. The production of synthetic fibres, plastics, insecticides, lacquers, and explosives all absorb considerable quantities of benzene and are represented on the panel.

The models and animated panels were constructed by G. T. Porter of Southgate, who developed a number of new techniques for the representation of rising vapours and falling liquids. The three stationary panels were produced by H. R. Allen who was responsible for the design of the show-case.

EASTERN JUNIORS IN BIRMINGHAM

Members of the Eastern Junior Gas Association are seen during a visit to the Essex works of John Wright & Co. Ltd., Birmingham. The visitors were welcomed by Mr. H. V. Slade, General Manager.

Holder Fire Put Out

Special precautions were taken by Glasgow firemen to control a recent outbreak of fire at a gasholder at the Tradeston gasworks of the Scottish Gas Board. The fire endangered other gasholders and a large oil tank in the immediate vicinity. Firemen climbed to the top of the 50-ft.-high gasholder to tackle the flames with the use of sand and a special foam chemical.

Better Management

The 12th national conference of the British Institute of Management, with the theme, 'Research—a Signpost to Better Management,' will take place in Bournemouth on November 6-8.

Mr. Michael Milne-Watson (extreme left), and Mrs. Milne-Watson (centre) chat with Mr. H. Royston Askew, Q.C. (extreme right) and Mrs. Askew, and Mr. Charles Francis, of Texas, at last week's cocktail party at Murdoch House.

Gas Council Entertains American Bar Association

THEN DELEGATES HEAR TALK ON NATIONALISATION

FOR the first time since 1924, this year's convention of the American Bar Association is being held in London. Last week the Gas Council gave a cocktail party at Murdoch House for the section of the 3,000-strong contingent of American lawyers which represents the American gas utilities.

The visitors were welcomed on behalf of the Gas Council by Mr. Michael Milne-Watson, Chairman of the North Thames Gas Board, in the absence of Sir Harold Smith, Chairman, and Sir Henry Jones, Deputy Chairman, of the Gas Council, who were both on the Continent on business.

Mr. Milne-Watson explained that the party was smaller than had been expected owing to delay in the arrival in Britain of the liner, Ile de France, in which many of the delegates were travelling.

Mr. Henry Lippitt replied, saying that his only regret was that the convention had been held in London only once in the past 33 years.

The following day, under the Chairmanship of Mr. Donald C. Power, of New York, papers were presented to delegates at the Charing Cross Hotel on aspects of the nationalisation of Britain's gas, electricity, and transport undertakings. Mr. Leslie F. Stemp, M.B.E., Legal Adviser to the Gas Council, spoke on the gas industry.

Mr. Stemp began by recalling the large number of works of different sizes which operated in Britain before nationalisation; and the different forms of ownership—local authorities, statutory companies, and non-statutory companies.

A feature of the gas industry at this period was Parliamentary control, Mr. Stemp told his audience. For example, there was the necessity to obtain authority to break open streets for main laying, etc.

The amount of land which might be purchased by gas undertakings was limited; undertakings were obliged to give and maintain a supply of gas to certain classes of consumer; there were controls regarding prices and dividends; and the share and loan capital of an undertaking was prescribed by Act or Order.

By the end of the first world war it had been realised that the gas industry was too restricted and fettered, and seven Government enquiries had investigated its affairs. There were too many small undertakings that could not afford the best technical advice on modern developments, or to carry out research on their own account. A feeling had consequently developed toward geographical integration.

At this time the industry had been hampered by price restrictions which barred the development of promotional tariffs. It had also suffered from the linkage of price with dividend, an arrangement which had endured until finally made ineffective by war-time factors.

Nationalisation had met these difficulties, Mr. Stemp continued, and went on to define for the visitors the functions of the area boards, of the Gas Council, and the powers of the Minister of Power.

There was a belief in the United States, Mr. Stemp said, that nationalised industries were not taxed. He explained the inaccuracy of this, and pointed out the different interpretation in the two countries of the words 'rates' and 'rating.' He then explained that the British nationalised gas board fixes its prices on strictly commercial principles as compared with the procedure in the United States where prices are decided by an independent tribunal before which a gas utility must establish its case for any increase.

The area boards had the right to introduce any form of tariff they considered expedient, Mr. Stemp continued, so that the industry had greater freedom than before nationalisation. At the same time the consumer was protected by the need for tariffs to be displayed, by the prohibition of preference to certain classes of consumer, and by the powers of the consultative councils which could go to the Minister of Power.

Mr. Stemp then explained that the boards must balance their budgets, but that the acquisition of any unreasonable surplus would be questioned in Parliament and made impossible by sheer weight of public opinion.

Concluding, Mr. Stemp said that while there were arguments for and against the nationalisation of industries it had worked reasonably well in the case of the gas industry.

In a general brief discussion which followed, the speakers said that tariffs in the nationalised industries had been held at reasonable levels, services had been well maintained except at isolated times of excessive demand owing to exceptional circumstances, and that, as far as satisfaction on the part of the public was concerned, there had at least been no litigation.

FUTURE OF THE AMERICAN COKE OVEN BY-PRODUCTS INDUSTRY REVIEWED

THE future of the coke oven by-products industry in the United States has been visualised by Mr. George L. Fleming, Engineer in the production department of Koppers Company, Inc. 'It does not require too much imagination,' he said, 'to see that by proper application and utilisation of the by-products, their value could be increased substantially, thereby reducing the coke production costs.'

By-product coke ovens were installed for the first time in America during 1893 and have made increasing contributions to industrial development there. Now, there are 81 operating plants with a total of 16,039 slot-type ovens.

Coal carbonisation, in the early 18th century, was in 'coaks' that yielded approximately 33% of the coal charged, with no attempts to recover the gases, Mr. Fleming recalled. Now, the U.S. national average is approximately 70%, but with a profitable utilisation of by-products released during carbonisation.

A coal chemical plant characterised as the 'mathematical average' for the American industry at the end of 1955 was used by Mr. Fleming in presenting his visualisation of the present and the future. Industry figures are from the latest available statistics of the U.S. Bureau of Mines. Figures for 1955 have been drawn from 'Mineral Market Report No. 2520,' dated July, 1956. Mr. Fleming made his original presentation with earlier data at a chemical, engineering and manufactured gas conference of the American Gas Association.

PRODUCTS OF U.S. CHEMICAL-RECOVERY COKE-OVENS, 1955

Annual coke capacity, as at Dec. 31	79,675,500 tons
Coal carbonising capacity	113,562,600 tons
Operating rate, annual average	92.5% of capacity
Coal carbonised	104,873,873 tons
Products	
Coke	73,584,214 tons
Gas, total	1,083,624,595 mill. cu. ft.
plant use, 34.4%	373,592,239 mill. cu. ft.
surplus, 63.7%	689,347,940 mill. cu. ft.
Tar	852,922,817 gal.
Ammonia sulphate or equivalent	1,045,798 tons
Crude light oil	297,497,792 gal.

MATHEMATICAL AVERAGE PLANT BY PRODUCT COKE-OVEN

Ovens	198
Annual coke capacity	985,000 tons
Daily coke capacity	2,700 tons
Annual carbonising capacity	1,400,000 tons
Daily coal carbonising capacity	3,840 tons

Yields

	Per ton of coal carbonised	Annual production at capacity operation
Tar	8.13 gal.	11,400,000 gal.
Ammonium sulphate	20.06 lb.	14,050 tons
Gas	10,330 cu. ft.	14,500,000 mill. cu. ft.
Crude light oil	2.91 gal.	40,700,000 gal.

Surplus coke oven gas, the by-product from this 'mathematical average' plant with greatest volume and value, was given first consideration by Mr. Fleming in his discussion. Of the total gas produced during the year, 34.4% or 4,500,000 mill. cu.ft. was used in the plant for underfiring and 63.7% or 8,340,000 mill. cu.ft. was either sold to public gas companies or was used for other purposes. The remaining 1.9% of the total gas volume was wasted.

Two plants are in operation in the U.S. in 1957, for low-temperature separation and purification of the various components of coke oven gas after removal of normal products. In Europe, Mr. Fleming notes, there are some 25 such plants. The coke oven gas, on leaving the existing purification apparatus in a typical plant, is compressed to approximately 300 lb. per sq. in. The nitrous oxides in the compressed gas are first oxidised to a state where they can be removed readily by subsequent scrubbing. The coke oven gas then enters a series of scrubbers for these operations.

Light oil remaining in the gas after the usual benzol washers is removed by scrubbing the compressed gas with wash oil. The light oil is recovered from the wash oil and returned to the crude light oil section of the coke plant. Wash oil, after regeneration, is returned to the scrubber for re-use.

The sulphur compounds, hydrogen cyanide, and carbon dioxide are removed by scrubbing the gases with ammonia liquor. These compounds are recovered during the regeneration of the ammonia liquor and can be processed further for production of sulphuric acid, and hydrogen cyanide or sodium cyanide.

Finally, remaining traces of ammonia are removed from the compressed gas stream by washing with water which is then followed by a caustic washer to remove all traces of carbon dioxide. This partially purified coke oven gas enters a series of heat exchangers for progressive cooling. All traces of water and condensable hydrocarbons are separated from the gas during cooling. They leave the system in the form of streams rich in propane, ethane, ethylene and methane. Any of these rich gas streams can be purified further by distillation for later use or returned as fuel gas.

The original coke oven gas leaves the last heat exchanger reduced to a stream containing only hydrogen, carbon monoxide and traces of other impurities. If hydrogen is to be used for production of synthetic anhydrous ammonia, liquid nitrogen is used to scrub the gases leaving the last heat exchanger in the removal of carbon monoxide and the final impurities. Otherwise, carbon monoxide and other impurities may be removed by scrubbing the partially purified gases with cuprous solutions followed by a caustic wash. The latter method produces substantially pure hydrogen that can be used for chemical synthesis or upgrading of products.

Synthetic anhydrous ammonia has been produced in America and Europe for many years, Mr. Fleming noted. In general, all processes consist of passing one volume of nitrogen and three volumes of hydrogen over a suitable catalyst with controlled pressures and temperatures where a portion of the hydrogen and nitrogen react to form ammonia. The ammonia produced is separated from the gas; the unreacted nitrogen and hydrogen are recycled. The various processes differ in the pressure at which the reaction takes place and in the design of reactor and accessories.

Processes with higher pressures usually permit reduction in the purity of the feeds. However, they require additional power to compress the feed gases. Activated iron catalysts are generally used. The activators include alumina, lime, potash, and other similar compounds. Carbon monoxide, carbon dioxide, and oxygen are harmful catalyst poisoners and must be removed from feed gases.

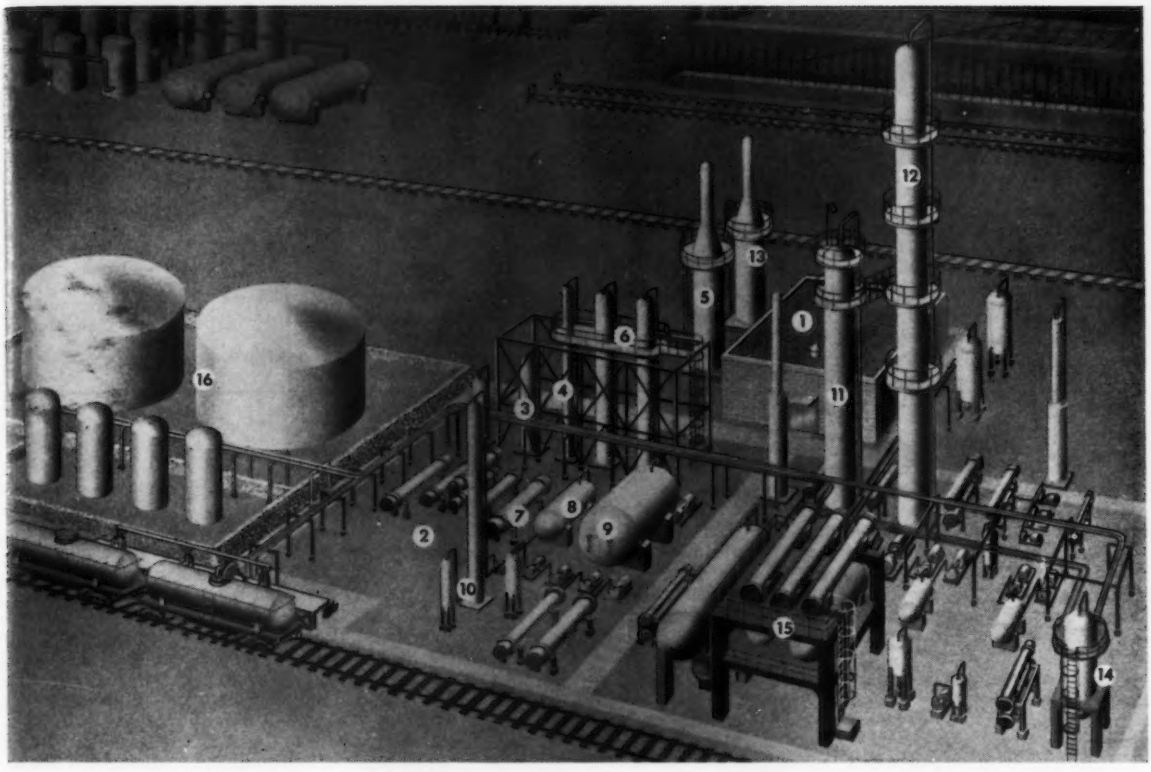
Among the uses of ammonia, Mr. Fleming referred to the production of nitric acid, ammonium nitrate and ammoniacal solutions.

VOLUMETRIC ANALYSIS OF COKE OVEN GAS IN 'MATHEMATICAL AVERAGE' PLANT

	Per cent
CO_2	1.8
C_2H_4	2.5
C_3H_6	0.3
C_4H_8	0.2
C_2H_2	0.1
O_2	0.2
CO	4.5
H_2	56.9
CH_4	29.3
Light oil	0.2
N_2	4.0
Total	100.0

H_2S content	400 grains per 100 cu ft.
HCN content	60 grains per 100 cu. ft.

One of the most useful products for the chemical industry in low temperature coke oven gas separation is an ethylene stream containing approximately 40 to 50%. With additional compression, refrigeration and fractionation, ethylene in coke oven gas may be recovered at a purity of 97% and above.



The Koppers refining plant for light oils.

1, Compressors, feed pumps and control room; 2, feed preheater and exchangers; 3, polymeriser; 4, evaporator; 5, reactor feed preheater; 6, reactors; 7, condenser cooler; 8, separator; 9, expansion vessel; 10, stabiliser; 11, extractor column; 12, stripper column; 13, aromatic evaporator; 14, clay tower; 15, solvent regeneration; 16, feed and product storage.

This ethylene can be used in production of ethylbenzene, polystyrene and synthetic rubber, or for production of polyethylene and any other chemical synthesis utilising this versatile compound. Other hydrocarbons, such as methane, ethane, propane may be treated thermally to produce ethylene or acetylene.

Hydrogen cyanide can be recovered and purified or it may be converted to sodium cyanide. Hydrogen sulphide, removed during purification, can be recovered, burned and converted to sulphuric acid. Additional yields of light oil can be realised by complete removal during purification. This light oil can be upgraded by utilising a new purification process.

Liquid nitrogen required for final purification of hydrogen in ammonia production is obtained from an air separation plant. Oxygen, an important co-product, has numerous uses in the steel and chemical industries. Inert argon is available also from the air separation plant for sale or for plant utilisation.

Any process is attractive only if it will show a profit. The economics of the 'mathematical average' plant were summarised by Mr. Fleming. He set the present value in U.S. sale of coke and the more usual by-products at £5 8s. 5d. per ton of coal carbonised. Then, he projected sales from additional by-products at £3 10s. 6¼d. per ton of coal carbonised. The total value in the U.S. market is the equivalent of £8 18s. 11¼d. per ton of coal carbonised.

PRESENT VALUE OF SALES OF COKE AND COAL CHEMICALS IN U.S.
Per Net Ton of Coal Carbonised

	£	s.	d.
Coke	4	1	8¼
Surplus gas		10	7½
Light oil and derivatives including naphthalene		6	0
Tar		4	5
Ammonia and compounds		2	6
Coke breeze		1	8½
Tar burned by producers		1	4½
Other products			1½
Total	5	8	5

PROJECTED ADDITIONAL U.S. SALES AND PROFITS FROM COAL CHEMICALS
Per Net Ton of Coal Carbonised

	£	s.	d.
Anhydrous ammonia	1	3	11
Ammonium nitrate	2	0	1½
Ethylene		5	1½
Benzene			5
Toluene			0¾
Xylene			0¾
Hydrogen cyanide			3¼
Oxygen		2	0
Argon, from air separation		3	7½
Sulphuric acid, 66° Be		1	7½
Total	3	17	2¾
Coke oven gas consumed		6	8½
Market value additional, net	3	10	6¼
Value of coke and more usual coal chemicals	5	8	5
Total, present and projected additional sales	8	18	11¼

The increased revenues in Mr. Fleming's projection assume coke oven gas separation and purification facilities; also an anhydrous ammonia synthesis loop. It is assumed that 50% of the ammonia produced will be converted to ammonia nitrate to facilitate handling and storage.

One of the newest developments in the industry is the demand for higher purity in light oil products, benzene, toluene, and xylene by the chemical industries. The coke oven industry, for many years, set industry's standards for the purity of these products. Now that larger quantities of petroleum aromatics are available, and at higher purity, users of these products are tightening the specifications.

The Koppers Company, Inc. now offers a new process for purification of light oil fractions. It combines experiences in both European practice and American petroleum practices using

COMPARISON OF BENZENE SPECIFICATIONS

	American Society for Testing Materials Specification D-835-50	Typical Petroleum Processing	Coke Plant Pressure Refined and UDEX Extracted
Specific gravity range 60°F/60°F	0.8820–0.8860	0.882=0.886	0.884
Thiophenes	—	Less than 1 ppm	Less than 1 ppm
Total sulphur	—	Less than 1 ppm	Less than 1 ppm
Chlorides	—	Less than 1 ppm	Less than 1 ppm
Solidification point	Not lower than 4.85°C	5.3—5.4°C	Higher than 5.4°C
Colour	Not darker*	Less than 0.003	Less than 0.003
Acid wash	1 to 2	Less than 2	Less than 1
Acidity	None	None	None
H_2S and SO_2	None	None	None
Copper corrosion	None	None	None
Bromine index	—	Less than 10	Less than 10
Carbon disulphide	—	None	None
Purity, %	—	99.6	99.8

* All lighter than solution of 0.0003 grams $K_2Cr_2O_7$ in one litre of water.

either coke oven gas, hydrogen separated from coke oven gas or pure hydrogen from other sources.

Coal tar, for many years, has been separated into its various components which find their way into virtually all parts of the American industrial economy. Of the nation's raw-material wealth, Mr. Fleming emphasised, none offers a more diversified source of chemicals. The classical products extracted include light oil, naphthalene, tar acids, tar bases, creosote, and pitches with various melting points, in addition to common road tars.

Current market demands are being met with continuously changing product patterns, the individual compounds that are separated and purified. The demand for naphthalene has been increasing rapidly during recent years, with consequent increases in the volume of extraction and purification of this important chemical building block.

The phenomenon of coal carbonisation was recorded first by Theophrastus, a pupil of Aristotle, about 371 B.C., Mr. Fleming commented. Early production was achieved with piles of coal covered with dirt, leaves and straw. It remained for the modern technologist to find the values in the foul-smelling gases that were produced. And even with the vast accomplishments now at hand, more products and more values can be expected with confidence—all of which will have favourable effects on the economies of coke and coke oven gas production.

The Koppers Process

This, briefly, is the Koppers process: Coke oven gas or hydrogen from a separation and purification plant is compressed to 600 to 900 lb. per sq. in., depending on the purity of the feed gases. Compressed gas is added to the recycled gas stream and preheated by heat exchangers. The crude light oil, when at operating pressure, is heated and held in a polymerisation chamber before being introduced in the vaporiser, where compressed heated gases supply part of the heat required for vaporisation.

Polymerised material is withdrawn from the base of the vaporiser. Crude light oil vapours and gases are preheated further before entering the reactor. On leaving the reactor, the sensible heat of the reaction products is utilised in preheating the feeds. A catchpot removes condensed liquids from recycled gases, which are then recompressed for recycling, after additions of fresh coke oven gas to maintain constant partial pressure of the hydrogen. A purge stream of gases from the catchpot removes undesirable components in the gases. The liquid product is depressurised and sent to a stabiilser column where dissolved gases and forerunning are removed.

The stabilised product is sent to a UDEX, a process developed by Universal Oil Products Company for purification of petroleum aromatics, extraction unit where it is further purified by rémoval of non-aromatic compounds called the raffinate. After removal of impurities, the product is water-washed and treated in a clay packed tower to reduce the bromine number. The BTX (benzene-toluene-xylene) fraction so treated is sent to a continuous fractionating plant for separation to pure benzene, toluene, and xylene.

Two main advantages are realised from this process: Coke plant BTX fractions are upgraded to meet the most rigid specifications and the acid sludge problem is eliminated completely. Feed to the pressure refining process may be either the total BTX fraction or any one of the compounds found in the fraction that have been separated by conventional distillation practices. Several successful German plants use the hydrogenation step in the process developed by Badische Anilin und Soda Fabrik and Scholven Chemie.

Operating costs for the refining and extraction process will amount to 1½d. to 4½d. per gal., in America, depending upon the size of the installation and local costs for gas and other utilities. The indicated approximate plant production cost includes laboratory expenses, plant overhead expenses, property taxes, and insurance as well as depreciation. It does not include depreciation of royalties. The refining and extraction costs must be compared with present acid washing and sludge handling costs. The increased yield of products compared with present yields obtained by acid washing, Mr. Fleming commented, will pay for increased refining expenses. That contention is based upon acid washed products having the same sales value as catalytic pressure refined products.

Investment costs will vary from £536,000 to £1,425,000 for pressure refining plants with annual capacities ranging from 10 to 50 mill. gal.

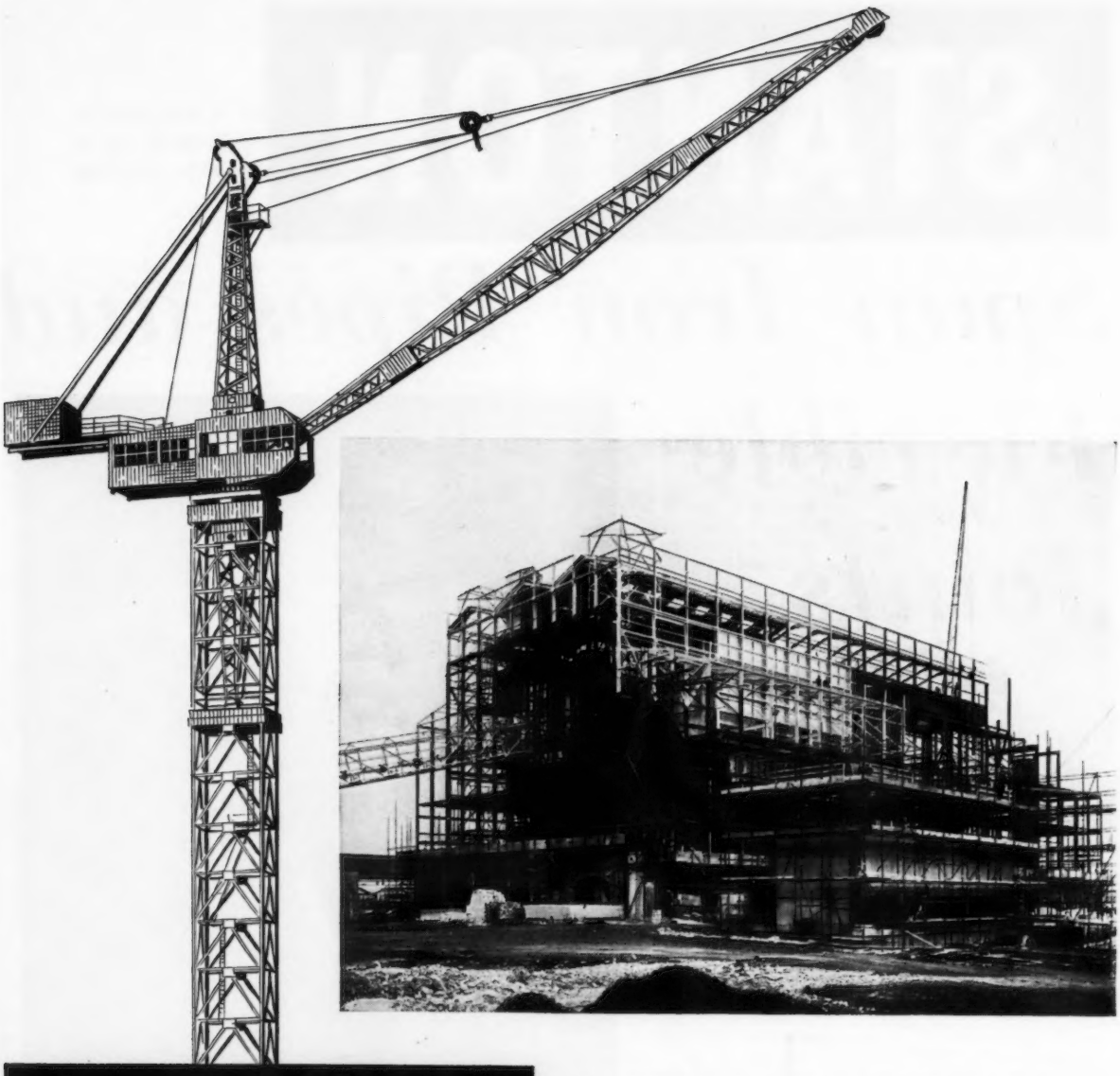
Status of Purchasing Officers

FOLLOWING the pilot survey carried out in 1955 the Purchasing Officers' Association has now carried out a comprehensive survey into its members' status and responsibilities, the results of which are summarised in a 12-page booklet. More than half the members of Chief Purchasing Officer status who completed the questionnaire form place orders for over £5 mill. each year and 70% of them are responsible direct to their Boards of Directors; 49% of them have control of staff employed in the stores. The contents also include information regarding the titles of members, the average number of staff controlled in purchasing departments of companies of different sizes spending from up to £5 mill. to more than £5 mill. per annum, and centralisation of purchasing. Other points covered are the purchasing of plant, market information and departmental statistics and costs.

Research for Industry

A SURVEY of industrial research in progress in technical colleges in the region during 1956 has been prepared and published under the title ' Research for Industry ' by the London and Home Counties Regional Advisory Council for Higher Technological Education. The survey shows striking development of collaboration between industry and the technical colleges on many diverse projects, and indicates that the generosity of industrial associations and firms in helping to enable research to be undertaken by the technical colleges is already reaping its reward.

The Council has also published its 1957 survey, ' Engineering Education in the Region.'



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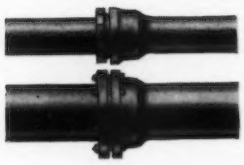

The Stanton Screwed-Gland Flexible Joint: up to 10″ diameter, inclusive

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THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Jet Burner Heating

A Press visit to Leeds in order to see the utilisation of high pressure 'jet' burners developed by the North Eastern Gas Board was reported in our issue of July 10. We are now able to publish a detailed description of the advantages gained by using these burners in certain exacting heating processes.

THE science of burner design has, until recent years, concentrated upon improvements in the entrainment and mixing of air and gas, and the attainment of the maximum rate of flame propagation throughout this mixture with minimum absorption of the pressure energies available in the gas, or gas and air streams. The rate at which combustion occurs is limited and, if the mixture volume issuing from the nozzle is too great, the flames will leave the burner and become extinguished. Under such conditions flame speed is exceeded by the mixture speed. It will therefore be appreciated that the rate of combustion of a theoretical mixture is controlled by three major factors:—

(1) The degree of admixture of any primary air supply with the gas.
(2) The rate at which air can diffuse into the gas from the atmosphere.
(3) Having now produced this mixture, the rate at which centres of combustion can become sufficiently close to unburned mixtures to promote their ignition.

The third factor is dependent, itself, upon such factors as the area of flame envelope, the temperature of combustible mixture, the initiation, breaking and branching of chain reactions which take place prior to actual visible ignition, and other complex factors, all of which can be said to be physical constants of the mixture and burner type.

From this it would appear that the fastest possible rate of combustion where air and gas is pre-mixed in theoretical proportions prior to the burner has been reached. If, however, the flames produced by such systems are surrounded with refractory tunnel, a rapid increase in combustion rates occurs. This is illustrated in Table 1.

Burner Type	Volume of gas burned cu. ft. per hr.	Volume of flame cu. ft.	Combustion rate B.Th.U. per cu. ft. flame	Flame Temp. °C.
Non aerated	600	·45	$·67\times10^6$	1,750 to 1,850
Aerated	600	·65	$·45\times10^6$	
Air blast	600	·145	$2·07\times10^6$	
Tunnel burners ..	600	·00345	115×10^6	
Lucas combustor used in aircraft jet engines	10,000		10×10^6	

By what mechanism is the combustion rate increased under these conditions? Unfortunately, we do not have the full answer, but an examination of the possible factors influencing combustion may be helpful. Early workers on this type of combustion came to the conclusion that the increase in combustion rate was primarily influenced by a catalytic reaction taking place along the refractory wall, exciting increased centres of combustion which would naturally lead to the more intense combustion as illustrated in the 'porous bed' type of mechanism.

Leason, working at Leeds University, showed, however, that even at these high velocities, the tunnel walls held round them a cool zone or 'a dead space' although, when compared with that of the normal Bunsen or air blast type of burner, it is much reduced in thickness. From temperature measurement and velocity distributions he concluded that the mechanism of combustion differed little from the more conventional systems, and that the refractory tunnel merely provided an incandescent ring at the base of the tunnel, stabilising the reaction. The turbulent conditions present within the tunnel gave rise to an increased flame area accelerating the progress of the flame front.

Howland and Simmonds, working for the Gas Research Board, found that in other types of burner systems, turbulence equal in intensity to that found in tunnel burners did not produce the high rate of combustion per unit flame volume. They examined other factors likely to produce this increased rate of combustion, i.e., a rapid heating of the air gas mixture by radiation from the tunnel walls. This was, however, eliminated as the time available was insufficient to materially influence the reaction. The effect of light beams on air-gas mixtures was then studied, since Norrish had shown ethylene combustion could be accelerated under the influence of light waves of some 3,600 Å. wave length but, as only small quantities of light of this wave length could be recorded as emitted from the tunnel wall, and intense light had little influence on the normal Bunsen cone, they concluded that its effects on tunnel combustion were negligible. They also found from stroboscopic examination of the flame that combustion took place as a series of explosions at high velocity and proved by spectrograph that the emission from the flame front is not typical of normal turbulent combustion, proving combustion to be of a very special nature.

Combustion of Static Air Gas Mixtures

When the explosive combustion should take place is not altogether clear and a short account of the combustion of static air gas mixtures would possibly throw some light on the problem. If a mixture of air and gas is exploded by means of a spark in a tube open at one end, the resultant flame travels from the closed end of the tube at a uniform velocity. Under suitable conditions it would then pass through a transition period of vibrational movement which accelerates to detonation where sonic velocities are attained. In the second stage of explosion, acceleration of the flame front takes place and a high concentration of shock waves, which have long been associated with ignition phenomena, are found to be present in the tube. It is possible that, under the influence of shock waves, the flame front is accelerated, retarded or even etxinguished. These shock waves are produced by external means, such as a spark ignition, or can be produced spontaneously in, or just behind, the flame front. Under favourable conditions the flame front can attain sufficient velocity to produce a highly luminous wave with the accompanying sound characteristic of detonation.

From a conception of this type the rapid increase in combustion rate occurring by surrounding a flame with a refractory tunnel can be explained—namely, when combustion takes place compression waves are radiated from a point at the base of the tunnel, are reflected by its walls and, upon striking the flame front, cause an increase in flame speed.

The presence of shock waves is abundantly clear from the high noise level produced by a tunnel burner. These sound waves are sufficient in magnitude to produce a deafening resonance of the whole gas stream within the tunnel. Research into sound production is now in progress at Leeds University, and when this is completed, it is hoped that it will throw further light on this problem, and possibly establish a definite theory of the mechanism of jet burner combustion.

Practical Advantages of Jet Burners

The rate at which heat can be transmitted to a solid surface by a gas flame is governed by two major factors:—

(1) Radiation from the flame.
(2) Convection currents created by the flame raising the temperature of the boundary layers held round such surfaces.

Although some heat processes at present use flame radiation

as the primary source of heat transfer, convection is the major heat mechanism employed in the bulk of cases. Using convection for heat transmission, products resulting from the combustion of the air gas mixture, at some 1,850°C. are impinged on the material to be heated. Looking closely into the impact of hot gases on to a cool surface, it is found that actual contact between these gases and the surface does not, in fact, take place, but rather do they pass their heat to a layer of stagnant gases held on the surface raising the temperature of this layer, which in turn, passes heat to the material being heated. Thus it will be seen that the rate at which heat transfer can take place is dependent upon three major factors:—

(1) Heat transfer co-efficient of this boundary layer.
(2) Temperature gradient across the layer.
(3) The thickness of the layer itself.

From this it will be realised that the thickness of the boundary layer is decreased by increasing the velocity of impact of the gases issuing from a burner. The heat potential of a burner is not merely dependent upon temperature of the stream of products issuing from it, but also upon the velocity or kinetic energy of this stream. In normal systems thermal expansion due to combustion of the mixture takes place in three dimensions and the resultant hot stream of products are increased little in velocity by this expansion. If the flame is then surrounded by a refractory tunnel of divergent or parallel cross section as in the normal tunnel burner, the expansion of products is restrained and much greater discharge velocities are achieved with an accompanying increase in the heating potentialities of the burner.

In the jet burner, however, not only is a three dimensional expansion obviated, but also, upon completing the combustion, the flow rate of the products up the tunnel to the point at which they are discharged to the atmosphere is accelerated. This is accomplished by using a convergent tunnel cross section. By the use of this convergent section, discharge velocities greater than 1,000 m.p.h. have been achieved. The heating potential is 15 times greater with a jet burner than that of the normal aerated burner; this figure has been compiled from tests carried out at the Industrial Development Centre at Bradford.

While heat input is shown to be vastly greater with jet type burners, the heat losses from the body being heated are the same regardless of the rate of heating and are the sum of conduction losses from the area being heated through the material itself and radiation losses.

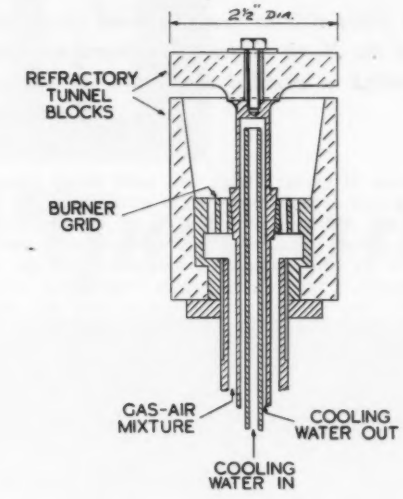
The times taken to reach equilibrium when plotting the heat losses from a 1-in. cube of steel, and the temperature at which it is established are shown in the table below and illustrate the remarkable results obtainable by this jet burner heating.

	Temp. attained at equilibrium °F.	Heat required to raise metal cube to equilibrium B.Th.U.	Velocity of products on to one face of cube ft. per sec.	Heating time required to reach equilibrium
Jet burner ..	1,520	46·0	754·0	3·1 mins.
Air blast ..	1,100	33·3	56·8	7·2 ,,
Aerated ..	810	24·6	24·7	12·3 ,,
Neat Gas ..	690	20·9	18·7	17·5 ,,

By the reduction in heating times and the higher temperatures attained, the necessity of surrounding the work to be heated with an insulating refractory chamber to prevent heat losses has been much reduced. Thus the development of furnaceless heating has emerged with the possibility of its extensive use.

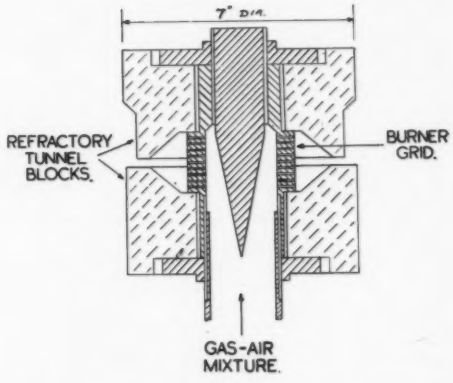
For the heat treatment of metals in industry, it is possible now, by the use of tunnel burners positioned correctly, to heat only a small portion of a complex structure without materially raising the temperature of the bulk of the piece, and a striking example of this is the preheating of valve seats prior to metal deposition. By the use of correctly positioned jet burners, shown in Figs. 1 and 2, internal seats of valves weighing up to 2½ tons can be raised to a temperature of 750°C. in some 12 minutes, although this seat is situated within a highly conductive structure. From this it can be realised that large production economies are likely when this unconventional method of heating is adopted.

A further illustration of the remarkable achievements of jet burner heating was demonstrated in the lap welding processes used by Clayton Son & Co., Ltd., for the production of high quality large diameter steel tubing. Plate is rolled to form



INTERNAL VALVE HEATING BURNER

Fig. 1.



INTERNAL VALVE HEATING BURNER.

Fig. 2.

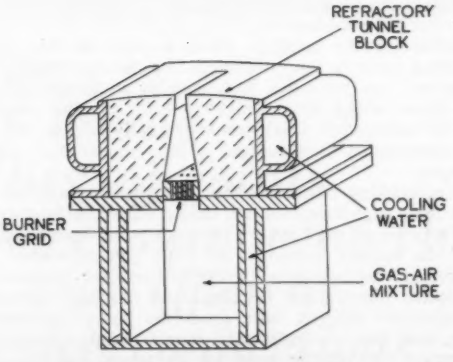


PLATE WELDING BURNER-INTERNAL

Fig. 3.

a ½ in. lap joint, which is then heated to some 1,500°C. and rolled under a pressure of 12.5 tons. Under the influence of this temperature and pressure, a weld of high quality is made. Since the attainment of this temperature—1,500°C. in open atmosphere with coal gas air mixture in conventional burners—is not possible, very large jet burners had to be designed and these are illustrated in Figs. 3 and 4 and demonstrated in action in Fig. 5. Although apparently simple in construction many problems have to be overcome in the production of jet burners, particularly in burners of these dimensions where up to 4,000 cu.ft. per hour of coal gas has to be burned within the limited combustion space of 0.026 cu.ft.

Need to be 'Tailor-made'

In the past efforts have been made to standardise burners, but in jet burners where the maximum point of heat release is only some 1 in. from the burner mouth, burners must be 'tailor-made' to the job in hand. If this is to be done, then the use of pre-fired blocks with the accompanying high pattern costs involved must be dispensed with, and materials suitable for ramming or casting used instead. As many of the latter brands are available, it would appear that a very wide choice exists but, while these are very excellent for smaller parallel sided or divergent tunnels, all are not suitable for jet burners with convergent tunnels. A short list of the arduous duties and required properties may help to illustrate this point:—

(1) The material must not subside or lose strength at temperatures as high as 1,750°C.
(2) The material should resist thermal shock since tunnel working temperature is attained in some 30 seconds.
(3) The fired and unfired mechanical strength of the material should be as high as possible as curing of the refractory is never completed in a tunnel and in the outer layers the material may rely upon unfired strength.
(4) Volume stability is also of great importance as will be realised from the previous requirement. If curing is incomplete any shrinkage or growth on firing will result in distortion with its resultant cracking.
(5) Thermal conductivity should be low to reduce the inevitable burner losses to a minimum and also because materials of high thermal conductivity will cause overheating of the perforated back plate which may, in turn, promote ignition of the mixture behind this plate, should the mixture velocity fall.

In view of the foregoing, the choice appears to be limited to those having the following constitution—

Alumina—greater than 60%.
Silica—less than 36%.
Impurities and alkali—less than 3%.

The grog size should be large and widely graded to give low shrinkage and high density.

The second and most serious problem with very large burners is the terrific noise produced. As previously stated the tunnel length is of prime importance in prevention of noise although many other factors are found to influence noise production. The major components of the burner which may influence noise are as follows:—

(a) Metal or ceramic back plate.
(b) Tunnel form.
(c) Tunnel material.
(d) Tunnel exit.

A study of these factors has led to the following rather empirical conclusions:—

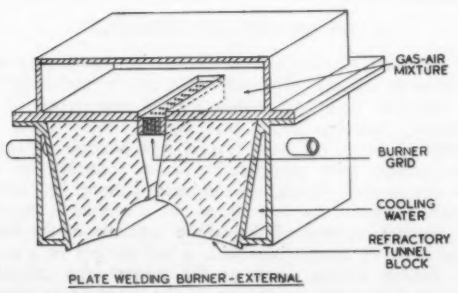


Fig. 4.

Fig. 5.

(a) The susceptibility of a tunnel to resonance has been found to depend upon the size of the perforations through which the gas and air mixture passes. The larger these perforations, the less likely is the tunnel to resonate as the flame front is reduced in area and is consequently positioned nearer the tunnel mouth. The size to which perforations can be increased depend upon the degree of turn-down required as a danger of burner light back is increased.
(b) The basic tunnel form or section is of great importance if resonance is to be avoided and the following general principles have been used as a guide:—
  (i) The parallel sided tunnel form should, whenever possible, be avoided as stabilisation of the combustion is difficult within these parallel sections.
  (ii) The tunnel with a convergent section, having equal taper to reduce reflection of sound shock waves within the tunnel, provides the greater stability.
  (iii) 10°-20° convergent taper is found most satisfactory but this is rather dependent upon the exit velocity required.
  (iv) Stagnant pockets of gas or areas of low velocity should be reduced to a minimum as turbulence created by these pockets may again cause instability.
  (v) It is important that burners be designed for the particular purpose for which they are required as is the general rule in all furnace work.
  (vi) Excess tunnel volume should never be permitted because resonance is favoured by such conditions. The burner efficiency, that is heat to work, suffers seriously in a turned down or an over tunnelled condition.
(c) In addition to the refractory properties previously mentioned the nature of the tunnel surface produced by a material is of importance in the prevention of resonance. It has been found that the smoother the material, the more likely it is to resonate.

The Use of Probes and Augers for Sampling Coal from Wagons*

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1. INTRODUCTION

THE sampling of coal contained in a wagon is a very difficult task because of the segregation of pieces of different sizes and of different composition as the wagon is loaded. For this reason it has always been recommended that, wherever possible, the coal should be sampled before it enters the wagon, or after it leaves it. Frequently it is possible to sample such coal from a belt or from a falling stream, and this is preferable to any method of sampling the coal from the wagon top.

There are times, however, when it is essential to sample the coal in the wagon. One example is for the determination of total moisture in the coal leaving a washery. As the coal stands it is liable to drain, so that to sample the coal as it is loaded would be misleading, since the moisture content is changing rapidly for the first few hours after loading and more slowly for several days. The only possibility is some type of digging method or a probe which can penetrate the lower layers of loaded wagons which have been set aside long enough for the moisture to attain a state of relative equilibrium.

2. DESCRIPTION OF PROBES

Several devices have been put forward to supply the need for a probe. These have included tubes placed in the wagon before filling, a canister which screws down into the coal, soil augers of various types, and a trough which is inserted into the coal. Three tools were chosen as being suitable for further testing.

The first was the trough sampler put forward by the Scottish Division of the National Coal Board. The sampling tool is made of $\frac{1}{8}$-in. steel plate. The slide engages with the lip of the scoop by two guides, one on each side of the slide. The scoop and guide are tapered at the point and streamlined wherever possible to facilitate penetration into the material to be sampled. The handle, which projects on either side of the trough, enables two persons to carry out the sampling operation. The scoop is strengthened at the top by welding on the outside a $\frac{1}{4}$-in. steel plate 8 in. long and shaped to the contour of the scoop at that point. With the same end in view, two strengthening plates of $\frac{1}{4}$-in. steel 8 in. long are welded to the outside of the top of the slide on either side of the mid-rib. The tubular steel handles are strengthened by means of a steel rod. The scoop weighs $14\frac{1}{4}$ lb. and the slide $17\frac{1}{2}$ lb.

The scoop is inserted smoothly, at a slight angle to the vertical; on no account should it be 'jigged' or jamming will take place. When it is fully inserted the two guides on the slide should be engaged with the lip of the scoop and the slide pushed right down. Care should be taken to keep the slide in alignment with the scoop. The handles of the scoop and slide should now be held in position by being grasped tightly together by a sampler on each side and both slide and scoop withdrawn as one. The trough was intended for use with coal having a top size less than $1\frac{1}{2}$ in. but even for washed smalls having a top size of $\frac{1}{2}$ in. it may be unsuitable if they are highly compacted during travelling. Two operators are always required and sometimes three are necessary.

The second device is the 'Tru-bore' soil auger manufactured by Hardypick Ltd. This consists of a flat disc shaped slightly to cut into the soil when turned, two opposite sections being in the form of flaps which allow soil or coal thrown up by the digging action to pass upwards through the disc. Underneath is a short screw thread to assist the auger to move downwards and the disc fits on a 3-ft. stem with a handle at the top. The stem can be extended if desired in lengths of 3 ft. For use in coal sampling a hoop of sheet steel a few inches deep is welded to the disc in such a way that it does not interfere with the operation of the flaps. It can be obtained with two sizes of disc—6 in. and 9 in. diameter. The 9-in. size can be used (with difficulty) for coals of up to $1\frac{1}{2}$ in. top size, but the 6-in. size is much easier to use, and is suitable for coals of top size $\frac{1}{4}$ in. or less. Washed slacks are easy to sample; the auger is screwed in to a maximum of a foot at a time, and the coal is removed until the depth is reached at which the increment is to be taken. The coal packs at the sides of the hole. It is, however, more difficult to take a sample from dry slacks. Holes must be made more cautiously, removing no more than 6 in. at a time, and the operator must keep his feet well away from the top of the hole, in order to avoid spillage from or collapse of the sides.

The third tool is a bucket-type auger manufactured also by Hardypick Ltd. This consists of two fixed curved blades mounted on a cross-piece attached to a 3 ft. steel or aluminium stem. The two blades, which together form part of a cone, fork and interlace at the far end. The loose partially dried coal is first cleared away at the point where the hole is to be dug. The probe is inserted, pressed down and twisted until the bottom section is filled with coal and then withdrawn. This process is repeated until the required depth is reached. The probe extracts about 2 lb. of coal at each insertion. Extension pieces are available and are fitted as required. This probe is not advocated for use when the material tends to flow but is suitable for washed smalls in wagons after about 48 hours' drainage.

Comments were obtained from the people taking part in the various tests. Four of the five people reporting on the trough probe had found difficulty in some cases. Two of them, on the other hand, found it was useful on small coal which had not been loaded for very long. The smaller sizes of earth auger were found to be suitable for washed coal, though there were difficulties when trying to sample dry coal. Difficulty was found in withdrawing the 9-in. earth auger.

3. PLAN OF EXPERIMENT

It is desirable that all probes should be thoroughly tested under a wide variety of conditions, and a series of tests of the different types of probes on different types of coal by different sampling teams was carried out. These tests were intended, first, to show that it was possible to use the different probes with comparative ease; secondly to show whether the probes yielded an unbiased sample, i.e., whether the moisture content (or ash content) of a sample is the same, on the average, as that of the whole contents of the wagon. This was done by comparison with a belt sample or a sample from a falling stream taken as the wagon was loaded (in the case of uncleaned smalls) or as the wagon was emptied. Thirdly there was a survey of variability within wagons, so

* By permission of the Journal of the Institute of Fuel.

TABLE 1.—BIAS IN SAMPLING WAGONS

Test	Probe	Type of coal	Belt sample		Bias in sampling			
			Moisture (total)	Ash (dry)	Moisture		Ash	
					Probe	Digging	Probe	Digging
1	auger	1 in. uncleaned smalls	10·5	19·4	+ 0·4	+ 0·2	+ 2·7	+ 2·4
2	auger*	½ in. washed smalls	12·8	8·6	− 0·4	− 0·9	nil	+ 0·9
3	auger*	1½ in. dry slack	12·2†	12·9	+ 0·7‡	− 0·2	+ 0·4	+ 1·0
5	trough	½ in. washed smalls	6·5	7·2	+ 0·3	+ 0·7	nil	− 0·4
6	trough	⅜ in. uncleaned smalls	3·2	20·6	+ 0·6	+ 0·2	+ 2·1	+ 1·9
7	auger*	½ in. washed smalls	10·6	8·4	nil	− 0·5	− 0·2	+ 0·2
8	auger	½ in. uncleaned smalls	9·8	9·8	+ 1.0	+ 1·4	+ 1·3	+ 1·2
9	trough	½ in. washed slack	19·8	8·0	− 0·8	nil	− 0·4	− 0·4
11	trough	½ in. opencast duff	7·9	17·0	− 0·1	+ 0·5	+ 1·6	− 0·4
12	6 in. auger ..	½ in. untreated smalls	3·1	20·6	+ 0·5	+ 2·7	+ 1·4	+ 2·5
13	trough	½ in. washed slack	9·6	5·6	+ 2·4	+ 0·9	+ 0·5	− 0·3

* Bucket type. † Subject to relatively large sampling error. ‡ Ignoring one anomalous subsample in belt sampling.

that it was possible to decide the way in which the increments were to be spread over each wagon. Fourthly several wagons were tested at each point, in order to study the between-wagon variability. The relative importance of the within-wagon and the between-wagon variability determines the best number of increments to take from each wagon.

It is not possible to take increments from every portion of the coal contained in a wagon. Any acceptable sampling routine would specify a limited number of positions from which increments are to be taken in rotation. In these experiments 27 positions were chosen, arranged in three layers, with nine positions in each layer. The layers are taken at one-sixth, half and five-sixths of the depth of the wagon. Three wagons of the same grade of coal were sampled using a probe, nine increments being taken from each. These were so arranged that, in any one wagon, each layer was sampled three times and each of the nine positions in the plan was sampled once, while over the three wagons all the 27 positions were sampled exactly once in one of the three wagons. In statistical terminology, the design is a one-third replica of an experiment involving four factors (level, width, length, wagon) each at three levels. Such a design makes it possible to separate out the variation due to differences between levels, ends and middle, sides and middle, and wagons, from the residual variation which cannot be allocated to these factors. Three more wagons were sampled on the basis of the present British Standard method. For the ash determination, samples were taken from the bottoms of holes dug with a spade, between 1 ft. and 1 ft. 6 in. deep. Three increments were taken from each wagon, but over the three wagons all nine positions were sampled. For the moisture sample one hole was dug to half the depth of the wagon in the centre of the wagon following exactly the present British Standard practice.

As each of the wagons was being loaded or unloaded, increments were taken from the falling stream or from the belt, alternate increments being placed into two containers. In this way it was possible to study to some extent the wagon to wagon variation. The present British Standard method could be compared with the belt method, and the probe methods could also be compared with the belt method. The increments were all analysed separately, using the methods of the current B.S. draft specification.

4. THE BIAS SAMPLING WAGONS

In interpreting the results it was assumed that normally the results of the belt sampling or falling stream sampling were unbiased. It could happen, of course, that in one particular test, owing to faulty sampling, the belt sample was biased, but to pick out such a test would require special supervision at the sampling point. Clearly the participants in the test thought that the belt samples were satisfactory, otherwise they would have commented to this effect. Table 1 expresses the bias of the wagon samples relative to the belt samples.

It is difficult to see any pattern in this rather heterogeneous collection of data. It was thought, however, that taking increments from only one level might improve the sampling, and Table 2 gives the moisture and ash contents for the top, middle and lower levels of the probed wagons, together with the average of the belt samples of the three probed wagons.

In the case of ash content there is no difference between the three levels in the wagon from which the increments have been taken. In four of the tests, however, the moisture content differed significantly from level to level. In Tests 1, 2 and 9 it is better to take the middle increments only, rather than average them all, since the top increments are unrepresentative. Test 13 is an exception, in that the top set of increments agree much better than the others with the belt samples. Reference to Table 1, however, shows better agreement in moisture content between the rug samples in the centre of the wagon and the belt samples, so that the weight of the evidence inclines towards taking increments for a moisture sample from half the depth of coal in the wagon rather than (*a*) taking a complete section or a representative sample from all levels, which is difficult in practice, or (*b*) taking a sample from near the surface.

This does not rule out the taking of several increments from

TABLE 2.—DIFFERENCES BETWEEN LEVELS IN WAGONS

Test	Moisture (total)					Ash (dry basis)				
	Top	Middle	Bottom	Av. probe	Av. belt	Top	Middle	Bottom	Av. probe	Av. belt
1	12·3	10·6	10·0	11·0	10·6	22·3	23·1	21·5	22·3	19·6
2	11·3	12·1	13·1	12·2	12·6	15·9	16·1	16·0	16·0	16·0
3	12·9	12·6	13·1	12·8	11·2 (12·1*)	13·2	13·6	13·5	13·4	13·0
5	6·6	7·0	7·1	6·9	6·6	6·8	7·1	7·1	7·0	7·0
6	3·8	3·7	3·8	3·8	3·2	22·9	22·4	23·7	23·0	20·9
7	10·2	10·2	10·7	10·3	10·3	7·2	7·8	7·6	7·5	7·7
8	11·3	11·2	10·7	11·1	10·1	9·7	10·9	10·7	10·5	9·2
9	17·8	19·3	19·6	18·9	19·7	8·0	7·6	7·2	7·6	8·0
11	7·3	7·7	7·8	7·6	7·7	18·4	18·2	18·7	18·4	16·8
12	4·2	4·3	3·7	4·1	3·6	21·3	22·6	22·8	22·2	20·8
13	9·9	12·4	12·5	11·6	9·2	5·3	5·7	5·9	5·6	5·1

* Rejecting one anomalous subsample.

half the depth of the wagon. Referring back again to Table 1, it is seen that for ash content the probe and digging methods agree fairly well with each other, but not always with the belt samples. This may have been due to an unfortunate selection of positions in the wagon, or to the belt samples themselves being biased. In Tests 1, 6, 8, 11 and 12 (all uncleaned smalls) these differences in ash content are considerable, and it must be concluded that a satisfactory method for sampling uncleaned smalls in wagons has not been found. The only possibilities of progress are a more satisfactory probe or, perhaps, a better allocation of the digging positions.

For the moisture content of uncleaned smalls, Tests 1, 3 (ignoring the anomalous result), 6, 11 and 12 seem reasonably satisfactory and probe samples may be taken in preference to digging holes. In sampling the washed smalls, for both moisture and ash, all tests are satisfactory, with the exception of Test 13 for which the moisture sample taken with the probe is unsatisfactory. All the three types of probe have given satisfactory results in some tests, and less satisfactory results in sampling uncleaned smalls. It may be concluded that, provided that the probe can be conveniently inserted and the sample recovered, the three types are equally suitable as far as bias is concerned, and the method of digging holes is no better and no worse.

5. VARIABILITY

It is clear from the design of the experiment that the aims have been limited. It is not possible to map out the variation in moisture and ash content in a single wagon, since it takes three wagons to cover the whole set of 27 positions (and, of course, the intermediate positions are ignored). Similarly it is not possible to study directly the variation at identical points in a series of wagons, since no two wagons are sampled in the same position. This difficulty is the inevitable result of trying to study a vast subject in a relatively small experiment. An examination of the variability within wagons (allowing for differences in length, width and level), showed that the variation increased rapidly with increasing moisture or ash content. By making the assumption that the variance was proportional to the average ash content it was possible to pool the results of the tests to a considerable extent. Similarly, it was possible to assume that the variance of the moisture was proportional to the average *free* moisture content. When this pooling was made, it was found that, as far as the ash content was concerned, washed and uncleaned smalls had to be dealt with separately. The residual variation for the uncleaned smalls was about twice that for the washed smalls, but the wagon to wagon variation was more than five times as great. One test (No. 12) gave an anomalously high residual variation. There were no significant differences between the three levels in a wagon, nor across the width, but there were significant differences along the length. Thus when sampling for ash content it is not necessary to penetrate to the full depth of the wagon; one-sixth of the depth or thereabouts is enough. But it is important to cover both ends of the wagon and also the middle, so that either the sampling position along the length of the wagon must be varied from wagon to wagon or several increments be taken along the length of each wagon.

The assumption that the variance of moisture was proportional to the average free moisture content, though better than nothing, did not account for all the differences in variance between tests. The tests were divided into two groups, within each of which the assumption applied. Uncleaned and washed coals overlapped into the same groups, and there was no obvious reason for the division. Within each group, there were significant differences between wagons, between levels in the wagon and along the length of the wagon, and in the less variable of the two groups there were differences across the width of the wagon. Thus when sampling for moisture content it is important to cover all portions of the wagon though the considerations of Section 4 showed that samples from the middle level of the wagon were often more satisfactory than average samples from all the three levels studied.

6. NUMBER OF INCREMENTS TO BE TAKEN FROM EACH WAGON

The proper allocation of increments to the wagons depends upon the relative variation between and within wagons, and on the relative costs of visiting an extra wagon and of taking an extra increment.

It was found that the ratio of variances between and within wagons $\left(\frac{V_w}{V_o}\right)$ varied from 0 to 3.3 on individual tests, for the ash content, and from 0 to 0.8 for the moisture content.

The relative costs of visiting the extra wagon (W_1) and of taking an extra increment (Wo) will vary greatly according to the circumstances. For consumers' sampling where all the wagons are available near the sampling point, $\frac{W_1}{W_o}$ may be as small as 2, whereas for producers' sampling $\frac{W_1}{W_o}$ may be considerably larger, particularly if the wagon had to be set aside to stand for several days. It might even be of the order of 20 or 50.

If n is the number of increments per wagon, the formula $n = \frac{W_1/W_o}{V_w/V_o}$ may be derived. This really needs to be evaluated for each particular problem, but it is suggested for simplicity of instructions that where each sampled wagon has to be stood specially n should be taken as 9 (or some more convenient number such as 8 to 10, corresponding to the dimensions and method of loading of the wagon). Where no standing is involved n should be taken as 3 provided sufficient wagons are available to give a small enough sampling variation.

7. NUMBER OF WAGONS TO BE SAMPLED FOR GIVEN ACCURACY

The number of wagons to be sampled to give a required standard of accuracy may be derived from Table 3, which gives estimates of 100 × sampling variance divided by average ash or free moisture.

Table 3.—Estimates of 100 x Sampling Variance ÷ Average Ash or Free Moisture

Test No.	Type of Coal	Ash			Moisture		
		$n=1$	$n=3$	$n=9$	$n=1$	$n=3$	$n=9$
1	Uncleaned ..	39·5	15·2	7·1	4·1	1·4	0·5
2	Washed ..	84·8	71·7	67·4	40·0	23·4	17·9
3	Uncleaned ..	49·5	23·4	14·7	26·4	16·5	13·2
5	Washed ..	11·1	7·4	6·1	7·8	4·8	3·8
6	Uncleaned ..	40·3	21·6	15·4	3·9	1·7	1·0
7	Washed ..	22·3	15·3	13·0	13·7	5·1	2·2
8	Uncleaned ..	35·6	20·4	15·3	49·4	19·5	9·5
9	Washed ..	34·8	28·0	25·7	5·7	2·8	1·8
11	Uncleaned ..	11·9	5·0	2·7	34·2	14·7	8·2
12	Uncleaned ..	116·2	63·7	46·2	28·9	17·9	14·2
13	Washed ..	35·3	22·9	18·8	32·2	13·9	7·8

Taking the largest figure in each column we obtain Table 4.

Table 4.—Largest Estimates of 100 x Sampling Variance ÷ Average Ash of Free Moisture

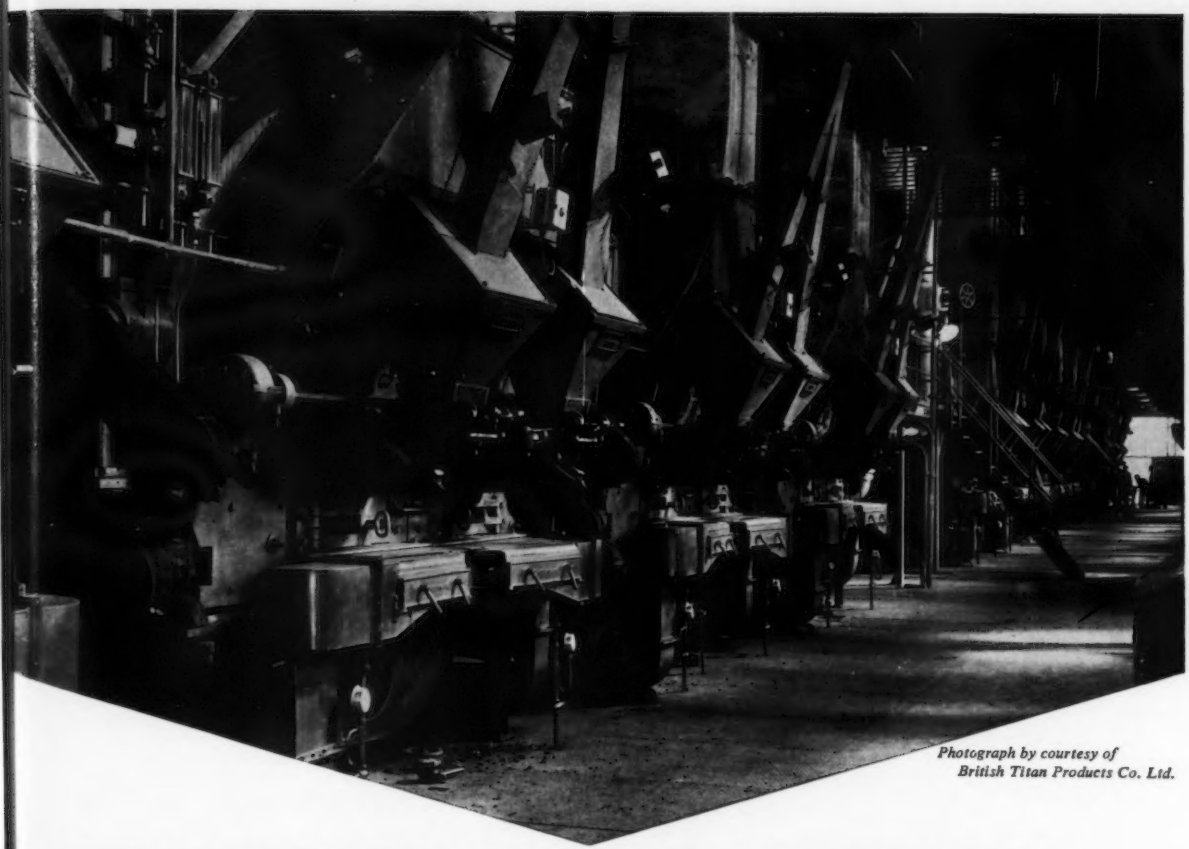
	$n=1$	$n=3$	$n=9$	Ignoring Vw $n=1$
Ash (uncleaned) ..	116	64	46	79
Ash (washed) ..	85	72	67	20
Moisture	49	23	18	45

The largest figure from the washed smalls for $n = 1$, 3 and 9 does not differ greatly from the largest for the uncleaned smalls, so a common figure is put forward: 116 ($n = 1$), 72 ($n = 3$), 67 ($n = 9$), as the estimate of 100 ($V_w + V_o/n$) ÷ average ash.

It is then possible to derive the number of wagons to be sampled to obtain a given accuracy by the formula

$$\frac{4}{A^2}\left(V_w + \frac{V_o}{n}\right)$$

where A is the accuracy specified. In view of the possibility of bias, it is unwise to use probes or any type of wagon top sampling when high accuracy is required. The standard that is to be attained is ± 1% of ash or moisture content when the



Photograph by courtesy of British Titan Products Co. Ltd.

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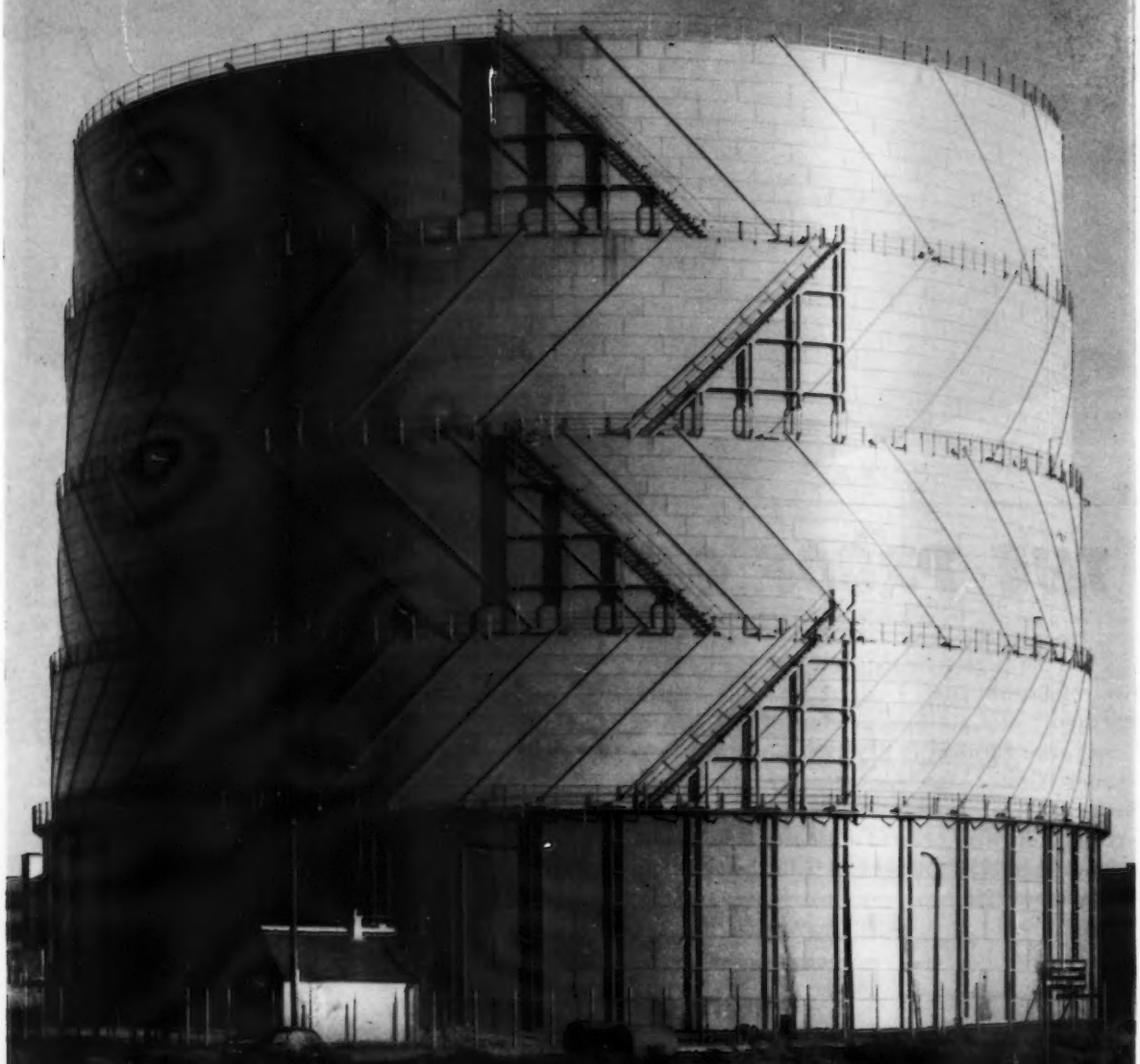

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ash or free moisture content is less than 10% and one-tenth of the ash or free moisture content when the ash or free moisture content is greater than 10%. The results are given in Table 5.

TABLE 5.—NUMBER OF INCREMENTS TO BE TAKEN

Determination	Increments per wagon sampled			Sampling all wagons	
	1	3	9	Uncleaned	Washed
Ash					
(0–5%)	24	45	126	16	4
(5–10%)	47	87	243	32	8
(10–15%) ..	47	87	243	32	8
(15–20%) ..	31	60	162	21	6
(20–25%) ..	24	45	126	16	4
Moisture					
(0–5% free) ..	10	15	36	9	
(5–10% free) ..	20	30	72	18	
(10–15% free) ..	20	30	72	18	

It may be seen from this table that increasing the number of increments per wagon from 3 to 9 greatly increases the weight of sample, but only slightly decreases the number of wagons which have to be sampled. Consequently there is no advantage in taking more than three increments per wagon, unless every wagon is being sampled. If every wagon is sampled, the weight of sample can be greatly decreased.

8. SUMMARY OF CONCLUSIONS

1. In practice the earth auger and the 6-in. 'Tru-bore' auger are satisfactory when sampling washed smalls up to ½-in. size for either ash or moisture content.

2. The 9-in. 'Tru-bore' auger and the trough probe are much more difficult to use and cannot be generally recommended.

3. When probe-sampling uncleaned smalls up to ½-in. size for moisture content it is difficult to prevent the coal falling back into the hole, but a satisfactory sample can be taken under favourable conditions.

4. No satisfactory mechanical method has been found for sampling uncleaned smalls from wagons for the determination of ash content, nor for sampling coal in wagons if the top size is above ⅜ in. For such coals digging methods may have to be used.

5. In sampling smalls (up to ½-in. size) for moisture content, the increments should all be taken from half the depth of the wagon and for this the two probes mentioned in conclusion 1 have some advantage over the digging method.

6. In sampling smalls (up to ½-in. size) for ash content the increments may be taken on any depth below 1 ft. and the probes have no practical advantage over the digging method.

7. When sampling from wagons the general rule is proposed that three increments should normally be taken per wagon—one from each end and one from the middle. If each wagon has to be set aside specially for any length of time before sampling, or demands a special visit to a plant, however, nine increments should be taken per wagon.

8. The number of increments to be taken is given in Table 5. It is impracticable to obtain the 'high accuracy' (± 0.5%) or even the 'normal accuracy' (± 1%) for coals having more than 10% of ash or moisture because of the possibility of bias.

9. In view of the considerable differences in variability from fuel to fuel, the method of duplicate sampling, or of taking the sample from a consignment in several sub-samples, is strongly recommended.

FROM THE CONTINENT . . .

25 YEARS LATER—VOLUME II

Taschenbuch für das Gas-und Wasserfach. II. Teil: Gas (Pocket Book for the Gas and Water Industries, Vol. II: Gas). Published on behalf of Deutscher Verein von Gas- und Wasserfachmännern by R. Oldenbourg Verlag, München. Price DM 16.—equal to about £1 7s. 6d.

THE first volume of this pocket book presented statistical and legal information together with all addresses of gas and water supply undertakings in Germany. The second volume, which has just appeared in print after a lapse of 25 years, contains a collection of fundamental technical data covering the whole field of the gas industry. Following the example of the well-known engineering pocket book *Hütte*. 22 leading personalities of the gas industry have collaborated with the Chief Editor in an aim to make this volume as indispensable to the gas engineer as the *Hütte* is for the German-speaking mechanical and electrical engineer. The information is of necessity given in a condensed form, and an extensive bibliography at the end of each chapter refers the reader to the latest articles or books published on the subject in Germany, U.K. and U.S.A.

The seven main chapters are entitled:—(1) Planning and construction of gasworks and supply systems, (2) Gas production, (3) Gas storage, (4) Gas distribution, (5) Meters, (6) Utilisation and (7) Control and costing.

The first two chapters, which take up 219 pages, form the main part of the book. The calculation and planning of distribution mains and the design of pressure regulators are two subjects which are explained in greater detail. The chapter on production includes a carbonisation section in which a comprehensive review of the various types of gasmaking chambers is presented. In the gasification section, all types of gas producers are described together with the Lurgi pressure gasification system. This chapter also contains a section on refractories, gas cooling, exhausters, tar separation and by-product plant.

The remaining chapters of the book include a detailed description of the various types of Continental gas meters, while some subjects receive only sketchy attention, with the exception of the section on street lighting by gas in the chapter on utilisation. As this pocket book is sponsored by the German Association of Gas and Water Engineers, it is assured of a good reception in Germany. To gas engineers outside Germany it presents a useful summary of present-day practice on the Continent.

New German Gas Appliances

AT the 1957 Spring Fair in Cologne, 67 of the 110 manufacturers of gas appliances in Western Germany had stands, writes K. Zimmer in the April 12 issue of *Das Gas- und Wasserfach*. Five leading manufacturers exhibited their gas cookers fitted with the new Junkers thermo-electric ignition failure device. In operation this device admits gas to the pilot jet only when the appliance is turned on. This heats up a thermocouple, the thermo-electric current of which attracts and holds the armature of the safety valve after a few seconds, allowing gas to pass to the main burners when the push button is released.

Gas Ring Control

A new automatic control for gas rings was shown by Krefft. As soon as the boiling temperature is reached, the gas ring is automatically turned to a small flame and simmering continues until a time switch cuts off the gas after a set time. The saucepan lid, which incorporates the device in its centre together with a flexible connection to the control mechanism, has concentric rings and fits all saucepan sizes. A new Junkers hot water heater incorporates an automatic water flow regulator which compensates for pressure variations in the water mains thus keeping the water flow and the set water temperature constant at all times.

Trade News

HIGH SPEED RESONANCE SCREENS

AS the result of an agreement between W. J. Jenkins & Co., Ltd., Retford, and Schuchtermann and Kremer, Baum of Dortmund, the Retford company has acquired sole licence to manufacture in the United Kingdom the complete range of high speed resonance screens which have been developed and tested over a wide field of application by the German patentees.

The new screens will be known as the Jenkins S.K.B. resonance screens and they follow the already familiar general design principles of resonance screening equipment. They are to be manufactured in six different widths from 4 ft. to 7 ft. 4 in. and in units of length to suit the material being handled.

Readily Modified

The upper limit for the length of one unit is generally in the region of 22 ft. and where longer screens are required two units may be arranged in tandem.

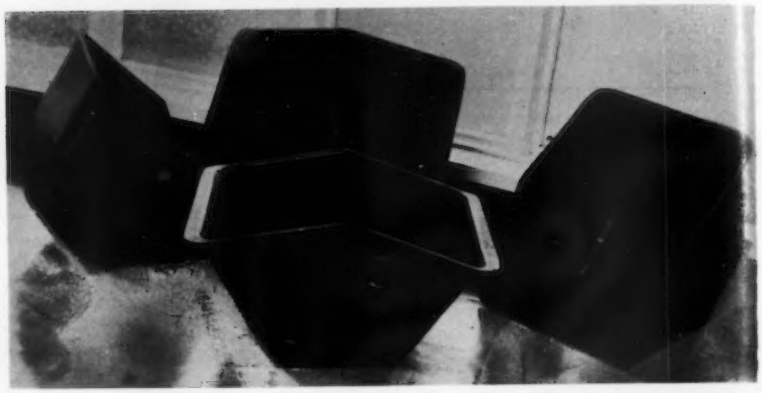
Inputs of up to 400 tons per hour can be handled depending on the density and size of the material and the vibration characteristics may be readily modified to suit the material and screening application.

In addition to normal high capacity screening this equipment is well suited to dewatering; slime removal, and similar applications and the clean lines of the tray make the screen easily adapted to the fitting of hoods for dust removal, leaving the suspension and drive accessible for inspection and maintenance.

W. J. Jenkins & Co., Ltd., have manufactured reciprocating screens for many years and their range of small high-speed vibratory screens are also well known in many industries.

The new range of Jenkins S.K.B. resonance screens are fully described in a leaflet which may be had on request from the manufacturers.—*W. J. Jenkins & Co., Ltd., Retford, Notts.*

GRAVITY FEED PLASTIC BUCKETS



Illustrated is a group of black gravity feed buckets for chain elevators which Universal Metal Products Ltd. (U.M.P.) are making from glass-reinforced plastic material, and which are used by the North Western Gas Board for carrying spent iron oxide on overhead conveyor systems. Other applications are the conveyance of chemicals, earth and various solid fuels. These buckets, measuring 14 in. by 19 in. including flange at the top, narrowing to 7 in. by 12 in. approximately at the base, with 1 in. flanges on short sides and ½ in. flanges on longer sides, 10 in. deep, have great tensile strength combined with light weight. They will not corrode, are resistant to weak acids and alkalis, and are relatively unaffected by humid atmosphere. Sizes other than the above are available, or can be made in special sizes if required in reasonable quantities.—Universal Metal Products Ltd., Langley Road, Salford 6, Lancs.

CHASESIDE 'ANT' DIESEL DUMPER

The Chaseside 'Ant' 1 cu. yd. diesel dumper, pictured here is designed for strength and simplicity, and can take heavy shock loads and be driven over rough sites without fear of damage. Having high ground clearance it cannot 'belly.' The skip is of all welded construction with base and back of ¼ in. and ⅜ in. steel plate. Truck capacity is one cu. yd. and the payload on uneven ground can be as high as 30 cwt., water capacity is 16 cu.ft. Even with this large capacity skip, the lip height is only 3 ft. 4½ in.—Chaseside Engineering Co. Ltd., Hayes, Middlesex.

'Ampin' Cyanide Emergency Kit

A NEW 'Ampin' emergency kit for treatment of cases of cyanide poisoning has been produced by Cuxson Gerrard & Co., Ltd.

Each kit is designed for the treatment of two patients by the method of Viana, Cognoli and Cendon. An 'ampin' of sodium nitrite 0.3 g. in 10 ml. is injected intravenously followed by an 'ampin' of sodium thiosulphate 25 g. in 50 ml. Neither 'ampin' need be removed from the case since each is provided with its own length of plastic tubing, drip chamber and flow control, and both are sterile units in themselves. Compared with the unpacking and assembling of syringes which must be filled repeatedly, and the technique of injecting at a fixed rate with a large syringe, much valuable time is saved with less trouble.

Clear Instructions

Also included are 'ampins' of nikethamide and lobeline for resuscitation, capsules of amyl nitrite, a card of clear instructions and all the adjuncts of intravenous therapy. The whole kit is housed in a quickly opened, perspex fronted, oak case with a handle for easy carrying.

This kit is not a substitute for the case containing solutions A. and B. which it is necessary to keep on premises where risk of cyanide poisoning exists, but is an additional and important aspect of treatment. Solutions A. and B. and ampoules of amyl nitrite housed in a wooden case are also obtainable.—*Cuxson Gerrard & Co., Ltd., Oldbury, Birmingham.*

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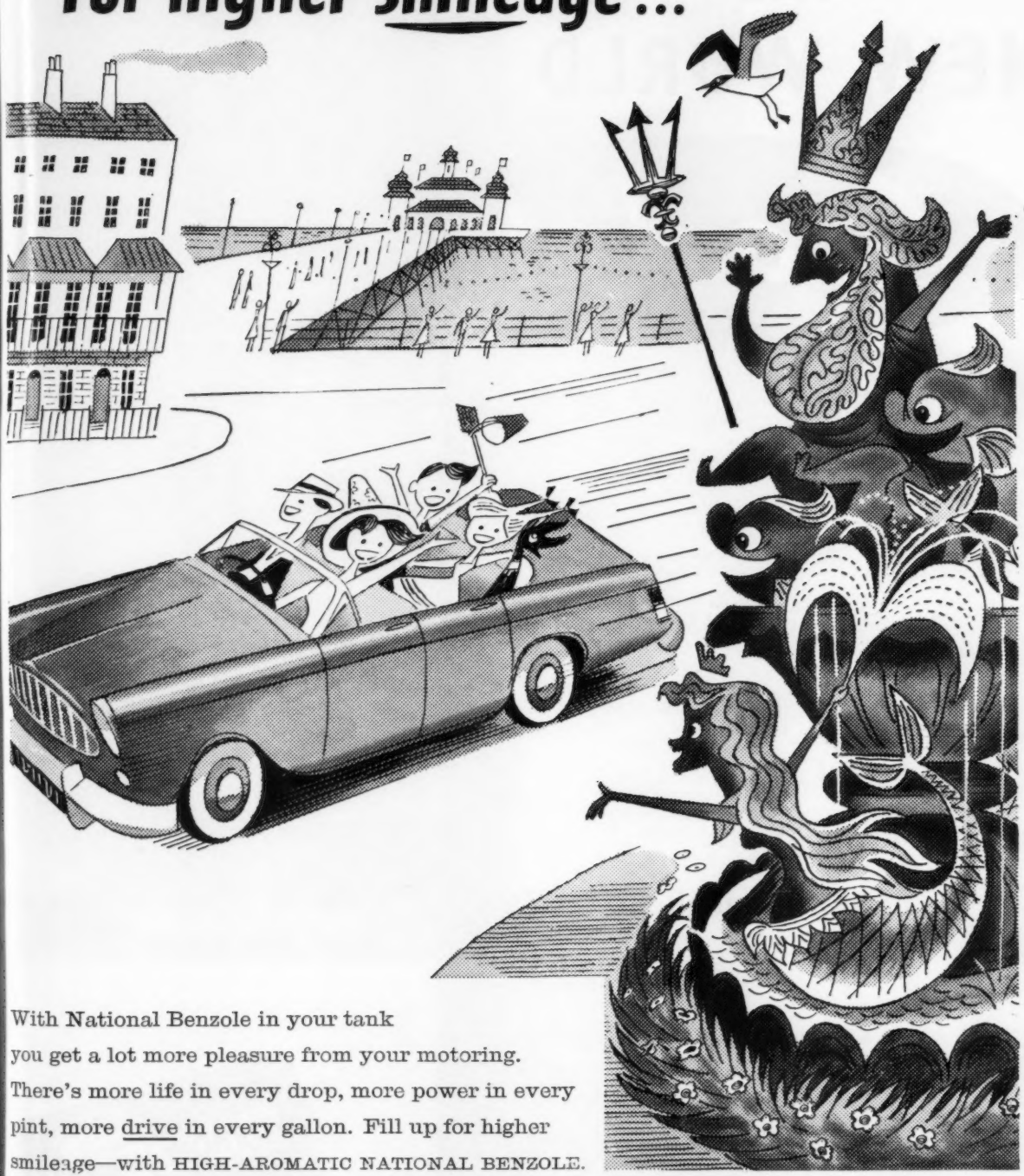

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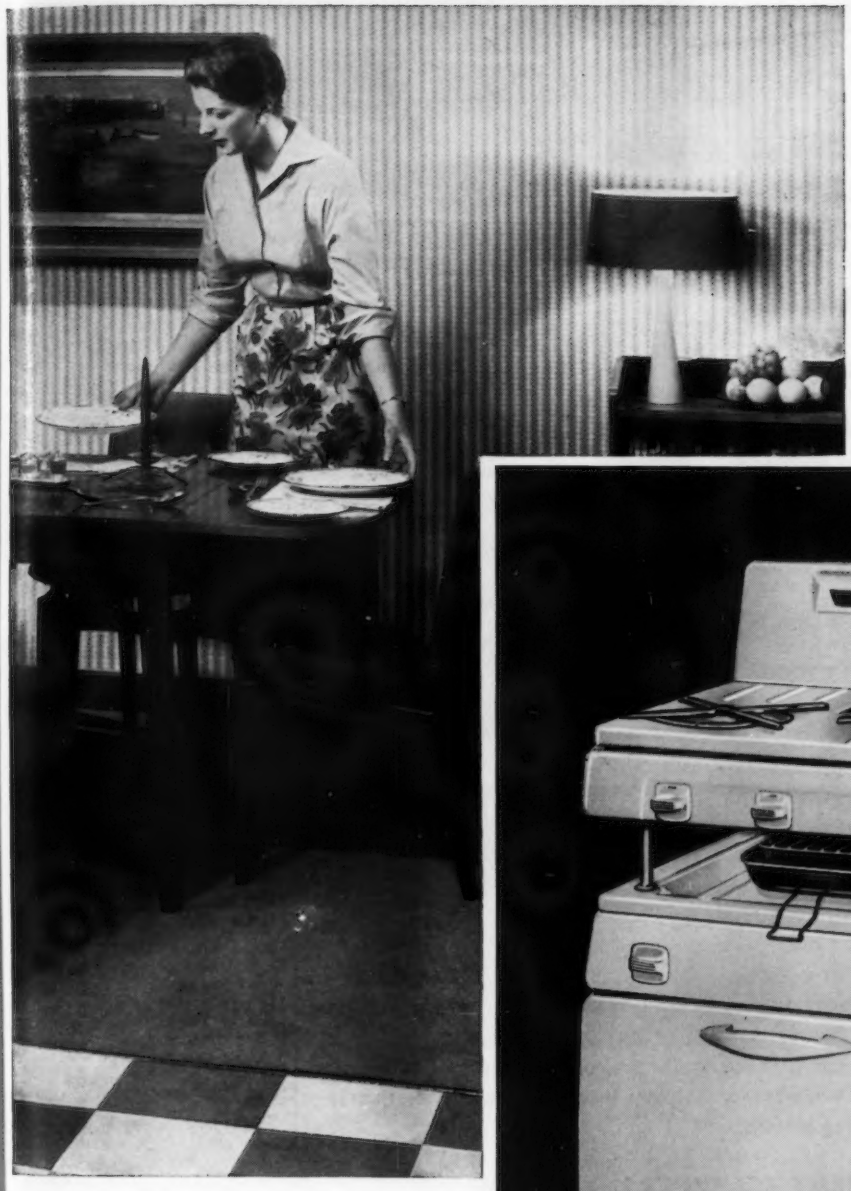

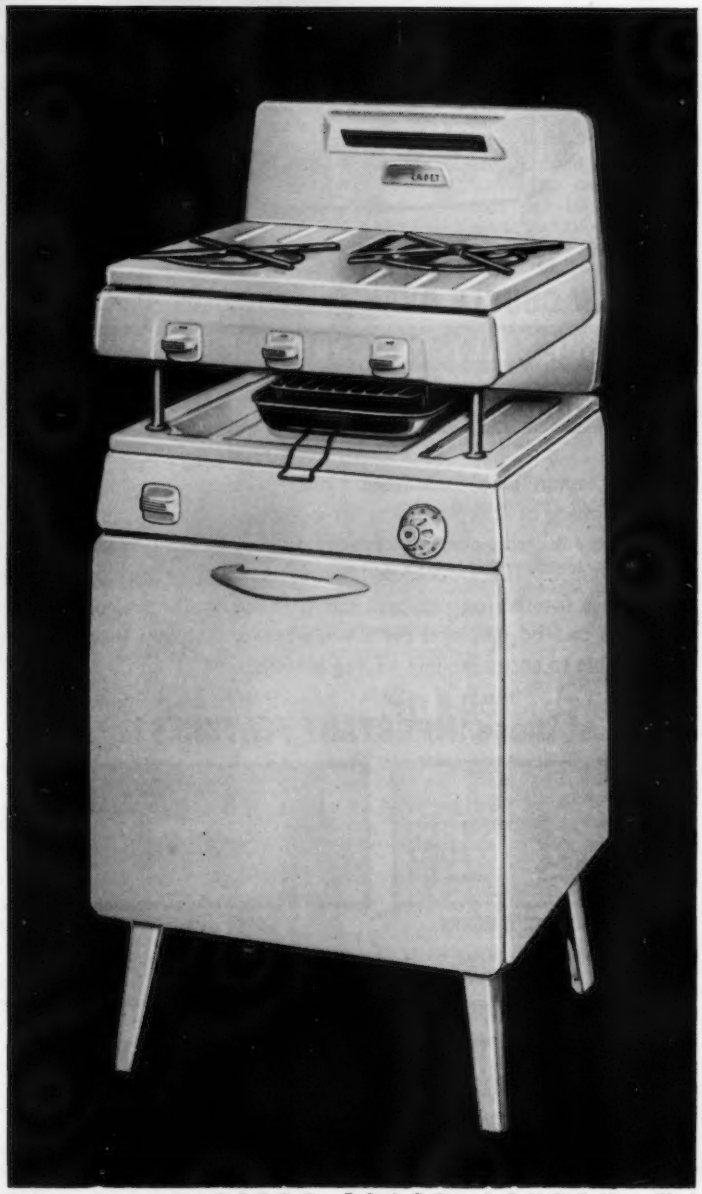

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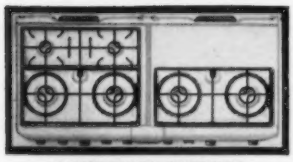

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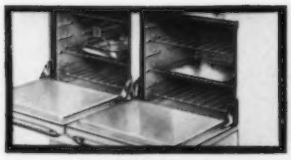

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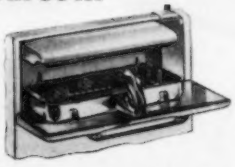

THE *FOLDAWAY* HIGH LEVEL GRILL

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PUBLICATIONS RECEIVED

The Lincoln Electric Story

TO commemorate the Company's 21st birthday and their move to new premises, at Welwyn Garden City—the same district as that in which they started their business—the Lincoln Electric Co., Ltd., have published a commemorative book giving details of their history, past achievements, and plans and ambitions for the future.

Although, theoretically, the history of the Lincoln Electric Co., Ltd., began in August, 1935, when the first Fleetweld electrodes were produced in a factory at Welwyn Garden City, there was considerable activity long before this date.

Prior to this a field sales organisation had proved the quality and efficiency of Lincoln products, introduced many prospective users to an improved system of electric arc welding and, in consequence, created a considerable demand for Lincoln products, technicians and techniques.

In these pre-production days considerable intense organisation had been taking place. A staff of research chemists and other experts had been gathered together, plant of a specialised nature designed and built, sources of material supply organised, operators trained, a sales system developed, and the countless other things that go to the setting up of a new company carefully planned.

By 1937 the complete range of Lincoln equipment was being manufactured. This led to the need for more space, more facilities, and more staff and so a two-storey block was added.

The war set the seal on welding as a process of absolute reliability, and one capable of effecting considerable economies and speeding up production. The Company played an important part in the recognition of welding as a process of vital importance to the war effort.

The story of these early days and the ensuing development and expansion of the Company are told in this interesting, well illustrated book.—*Lincoln Electric Co., Ltd., Welwyn Garden City, Herts.*

New Order Highlights Popularity of Gas Carburising Plant

The charge end of the Birlec continuous gas carburising furnace in operation at the Ford Motor Company's Dagenham works, showing, on the left, the control panels and pusher mechanism. On the right of the main unit is the tempering furnace.

BIRLEC, LTD., provide evidence of the still growing popularity of gas carburising as a case hardening process with the announcement of further important installations commissioned or in hand. These are continuous gas carburising furnaces for the Ford Motor Company, Ltd., and for British Timken, Ltd.

The Ford Motor Company now have two Birlec continuous gas carburising installations at their Dagenham works, one in operation and one under construction. Both are of the gas-fired, double track type.

The first of these, which has now been in operation for some time, is engaged in carburising pinions at a net output of 600 lb. per hour, based on a cycle time of 20 hours. The second is of the same basic design, but is intended for the carburising of gears at a rate of 530 lb. of components per hour, with a consumption of only 2,130 cu.ft. of gas.

Another large continuous gas carburising furnace has been ordered recently by British Timken, Ltd. It is for a complete installation for the heat treatment of bearings and includes a pusher type subcritical annealing furnace, a roller hearth hardening furnace, a slat conveyor tempering furnace and gas plant for the carburising, annealing, and hardening units.

The main furnace will be required to carburise, at 925°C., 360 lb. of bearing cups and cones per hour, with a total cycle time of 24 hours, made up of 16 hours for heating and carburising and 8 hours for diffusion. With an output of 2.5 trays of work per hour, this means that a total number of 60 trays will be required in the furnace, 20 on each track.

Quenching and cleaning equipment will be provided with the furnace, and with the exception of the loading and unloading of trays and the charging of the charge vestibule, all the furnace, quench and washer movements will be automatic. —*Birlec, Ltd., Erdington, Birmingham.*

P.V.C. Ducting

Horwitch Smith & Co., Ltd., have issued a new bulletin describing their Oxythene Duoply laminated PVC ducting. This ducting is now available in a complete range of sizes and types and all the sizes shown on the leaflet are generally kept in stock.

Using these prefabricated sections any heating and ventilating engineer with only an elementary knowledge of plastic welding can erect a corrosion free fume ducting system.—*Horwitch Smith & Co., Ltd., 42, Lower Loveday Street, Birmingham 19.*

Refractories

The Lafarge Aluminous Cement Co., Ltd., have printed a completely rewritten booklet, 'Refractory Concretes,' giving full information on materials for making, mixing, and placing refractory concrete.

They have also issued a booklet giving the names and addresses of suppliers of refractory concrete aggregates and insulating concrete aggregates; also manufacturers of proprietary castable mixes and refractory concrete pre-cast units. Both are obtainable free of charge.—*Lafarge Aluminous Cement Co., Ltd., 73, Brook Street, London, W.1.*

'SpYder' System

An illustrated pamphlet and price list of 'SpYder' system portable lifting and handling equipment has been issued by the makers.—*Aldridge & Ranken, Ltd., Avonbank Works, Bath, Somerset.*

Telemeter

Bailey Meters and Controls Ltd., have issued their brochure, 'Specification (E) E 11-13' describing fully the Bailey strip chart telemeter recorder.—*Bailey Meters and Controls, Ltd., Moorgate Hall, 155, Moorgate, London, E.C.2.*

Chain Drives

An illustrated folder describing seven ways in which Renold stock chain drives can give increased production in the factory has been issued by the makers.—*Renold Chains Ltd., Renold House, Wythenshawe, Manchester.*

New Eversheld Differential Pressure Transducer Type ER. 125

THE Eversheld differential pressure transducer type ER.125 converts differential pressures into an electric direct current signal suitable for remote indication, or as the 'measured value' signal for an Eversheld electronic process controller. This transducer's output may also be employed as one of the input variables for the Eversheld simple analogue computor.

The materials employed in the construction of the transducer make it suitable for application to processes involving oil, viscous or corrosive fluids as well as water, steam or gases.

The transducer type ER.125 will operate over protracted periods with the minimum of maintenance and it is constructed to withstand severe operating and climatic conditions. Its maximum temperature rating is 177°C.

The advantages of the Eversheld electronic repeater system on which this transducer is based fully apply, and it is thus unaffected by variations in the mains voltage or frequency, and no inaccuracy results from changes in the transmission line resistance or the inclusion of additional display or recording instruments.

The continuously adjustable ranges covered by transmitters type ER.125 are 0-5 W.G., 0-50 W.G. and 0-200 W.G. Maximum working pressures up to 1,000 p.s.i. Accuracy ± 1% of F.S.D. The output signal can be arranged as either 0-15 mA or 0-30 mA.—*Eversheld & Vignoles Ltd., Acton Lane Works, Chiswick, London, W.4.*

Sales Agreement

THE A.P.V. Co., Ltd., has concluded an agreement with the Rosenblad Company of Stockholm, Sweden, for the exclusive manufacture and sale of the well-known Rosenblad heat exchanger in Great Britain. A.P.V. will also be responsible for its sale in the Commonwealth, except Canada, and in the Middle East. The manufacturing and selling rights were previously held by Ashmore, Benson, Pease & Co. Ltd.

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NORTH EASTERN GAS BOARD require a GRADE 1 GAS FITTER in their Shipley District. J.I.C. rate of pay. Service house available on rental. Ability to drive motor van an advantage. Medical examination may be required.

Applications, giving details of experience and qualifications to the Group General Manager, North Eastern Gas Board, Britannia House, Bradford, by August 14, 1957.

J. C. GARDNER,
Secretary.

SENIOR REPRESENTATIVE required in London to promote the sale of gas appliances to Gas Boards, architects, local authorities and the building trade. The man we are looking for is between 27 and 40, of pleasing personality and with the ability to establish friendly business relations with senior executives and professional people. A thorough knowledge of the gas industry is essential and experience in the other fields desirable. Car provided. Good remuneration by salary and annual bonus. Usual expenses paid. This is not a job for a junior representative and applications will be considered only from candidates of proved ability and the requisite standing. Apply in writing, giving full details of education, qualifications and experience to General Sales Manager, Ascot Gas Water Heaters Ltd., 255, North Circular Road, London, N.W.10.

EAST MIDLANDS GAS BOARD

NOTTS. & DERBY DIVISION
TECHNICAL ASSISTANT (DISTRIBUTION)—BURTON-UPON-TRENT DISTRICT

APPLICATIONS are invited for the above appointment from persons holding at least the ordinary grade certificate in Gas Engineering (Supply) or equivalent. Applications are also invited from persons qualifying for the above examination.

Applicants should have a thorough knowledge of modern methods of distribution including high and low pressure systems and should be capable of carrying out the detail work in connection with the planning and estimating of new work.

Persons with the required technical qualifications will be graded in A.P.T. 5/6/7 (£605/£785) according to age and experience; persons in the process of qualifying will be graded in A.P.T. 3/4/5 (£445/£685) according to age and academic progress already achieved.

The position is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age and giving details of education, training and experience together with the names of two referees should be addressed to the undersigned to arrive not later than Saturday, August 10, 1957.

K. L. PEARCE,
Divisional General Manager.

East Midlands Gas Board,
Notts. & Derby Division,
P.O. Box No. 62,
Friar Gate,
Derby.

EAST MIDLANDS GAS BOARD

NOTTS. & DERBY DIVISION
APPOINTMENT OF AN ASSISTANT DIVISIONAL DISTRIBUTION ENGINEER

APPLICATIONS are invited for the position of ASSISTANT DIVISIONAL DISTRIBUTION ENGINEER in the Divisional Distribution Engineer's office at Derby.

Applicants should hold the Higher Grade Certificate in Gas Supply of the Institution of Gas Engineers, or its equivalent, and must have had thorough training and experience in modern distribution practice. The successful candidate will be required to assist the Divisional Distribution Engineer in a wide variety of duties including, from time to time, the design of distribution systems, the supervision of the laying of high pressure grid mains, the carrying out of pressure and load surveys and temporary relief duties within the Division when required.

The appointment will be made initially in A.P.T. 9 (£795/£895), but there will be scope for promotion to A.P.T. 10 (£860/£960) for the man who proves his ability successfully to assume greater responsibilities.

The post is pensionable and the successful applicant will be required to pass a medical examination.

Applications giving details of age, education, qualifications and experience, together with the names of two referees should be addressed to reach the undersigned not later than Saturday, August 10, 1957.

K. L. PEARCE,
Divisional General Manager.

East Midlands Gas Board,
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GASFITTER/GRID CONTROL ATTENDANT—KETTERING

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Applications stating age and present position, and giving details of qualifications and experience, together with the names of two referees, should be submitted to Mr. D. A. Foster, Group Manager, Commercial Place, Wellingborough, not later than August 24, 1957.

H. B. TAYLOR,
Divisional General Manager.

Leicester.
July, 1957.

CITY OF INVERCARGILL GAS DEPARTMENT

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WORKS SUPERINTENDENT

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A knowledge of Gas Distribution is desirable.

Commencing salary is £900 per annum, rising to £1,000 per annum by two annual increments.

Applications giving details of age, education, training, experience and qualifications, together with not less than two recent Testimonials, also a recent photograph, should be adressed to the undersigned.

W. M. TAYLOR,
Gas Manager.

SCOTTISH GAS BOARD

EDINBURGH AND SOUTH-EASTERN DIVISION
DISTRICT SUPERINTENDENT—GRANGEMOUTH

APPLICATIONS are invited for the above appointment from candidates having suitable qualifications and experience. The successful candidate will be responsible for Consumer Service and Sales in Grangemouth.

The salary scale for the appointment is Grade APT. 7/8 (£705-£825). The post is pensionable and the successful applicant will be required to pass a medical examination.

A house on rental is available.

Applications stating age, and giving particulars of education, training, experience and qualifications together with the names of two referees should be addressed to the undersigned within 14 days of the appearance of this advertisement.

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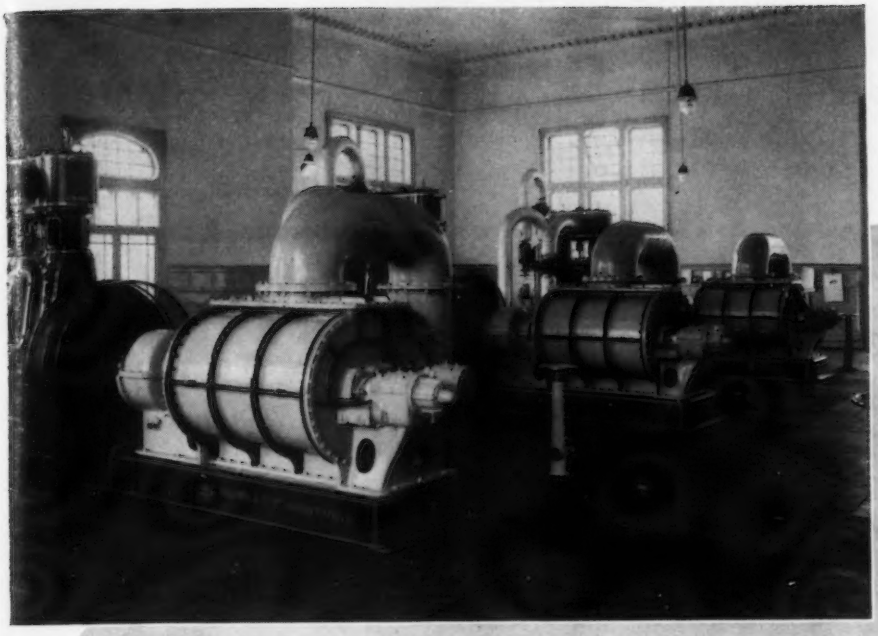

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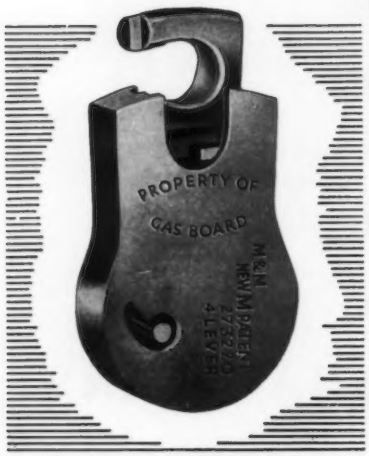

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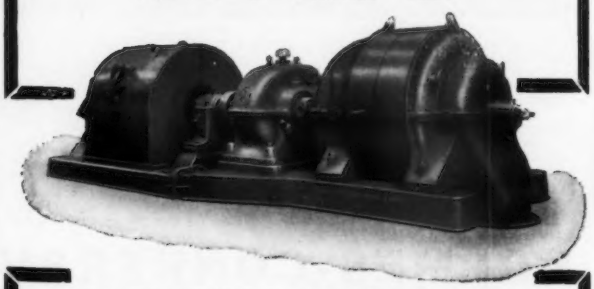

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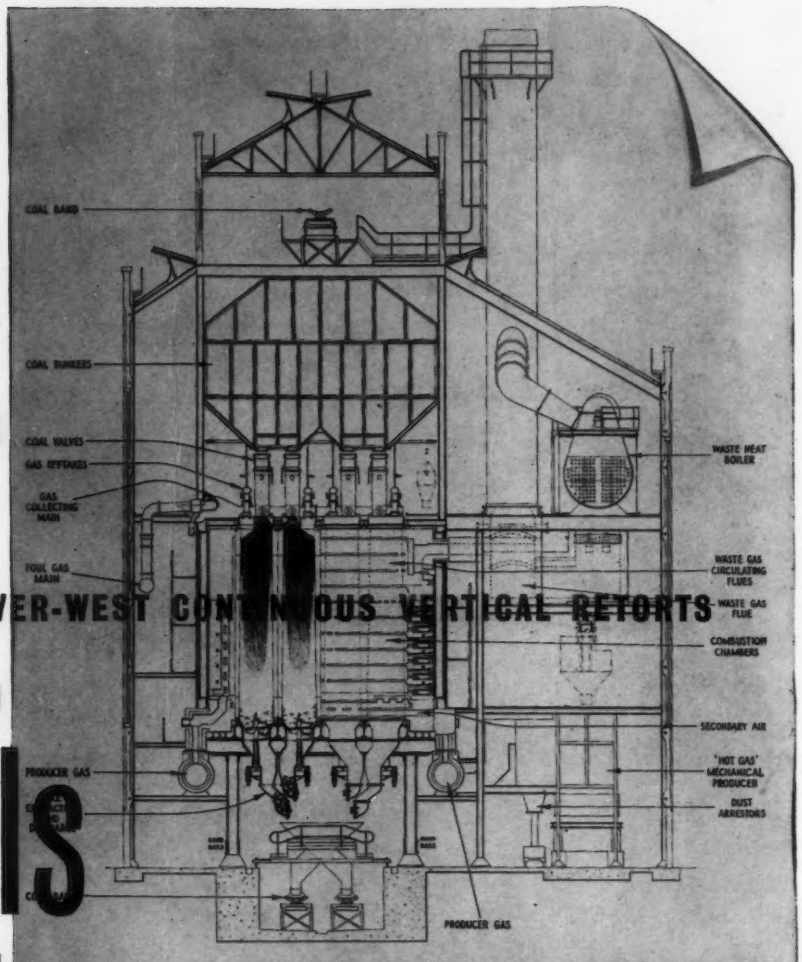

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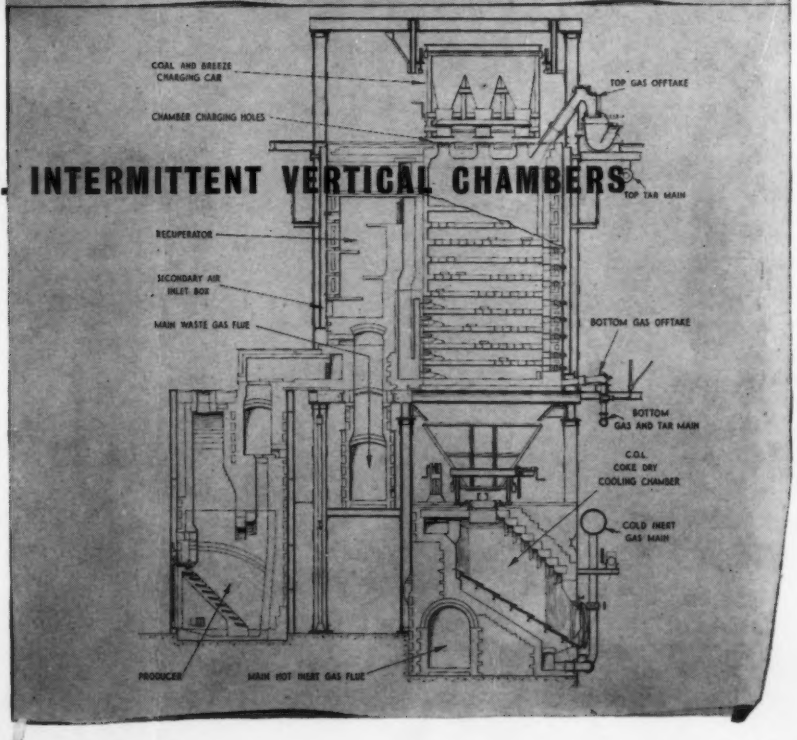

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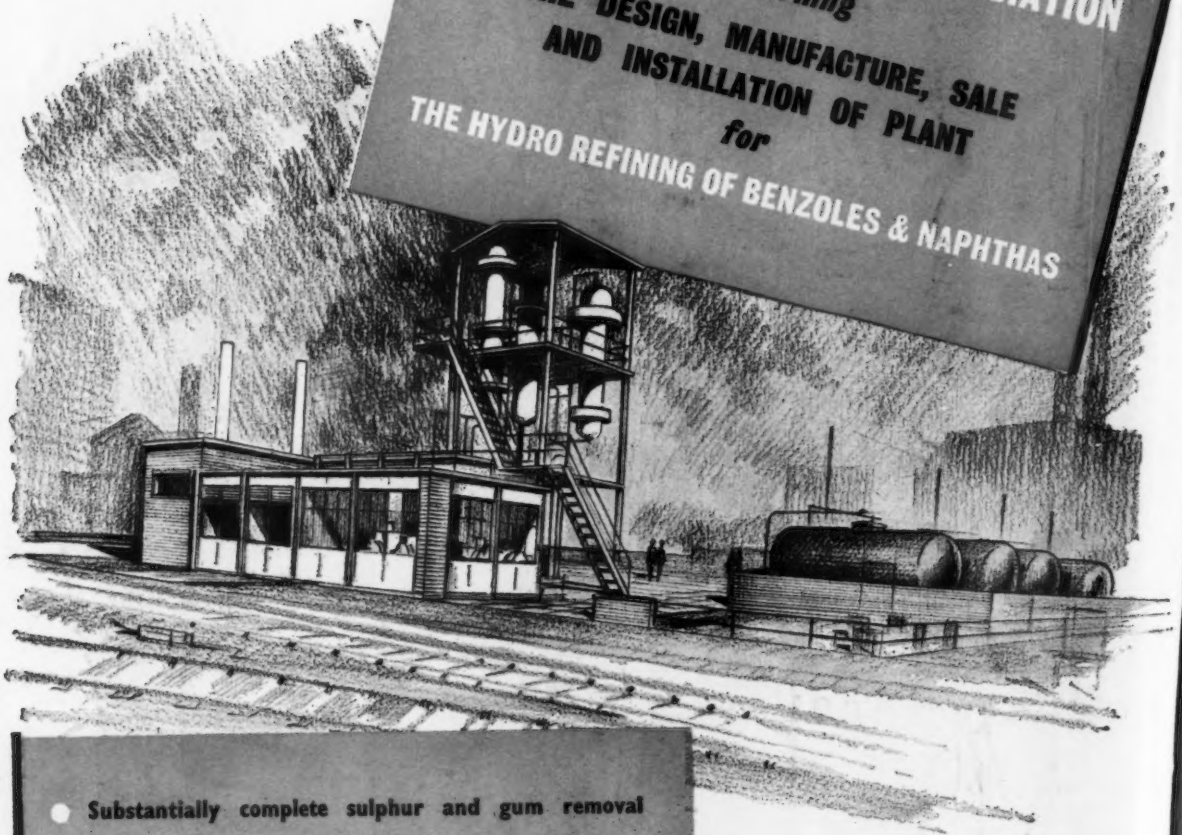

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